



LEARNING THROUGH PLAY: THE USE OF GAMES AS TOOLS FOR TEACHING OPHIOLGY IN SCHOOLS IN RIO GRANDE DO SUL

BRINCANDO QUE SE APRENDE: UTILIZAÇÃO DE JOGOS COMO FERRAMENTAS PARA O ENSINO
DE OFÍDIOLOGIA EM ESCOLAS DO RIO GRANDE DO SUL

APRENDER JUGANDO: USO DE JUEGOS COMO HERRAMIENTAS PARA LA ENSEÑANZA DE LA
OFIOLOGÍA EN ESCUELAS DE RIO GRANDE DO SUL

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Abstract: his study aimed to develop and implement educational games as a tool for teaching herpetology and promoting snake conservation in schools in Rio Grande do Sul, Brazil. This applied study was conducted within the scope of the extension project *Serpentes na Escola (Snakes at School)*, in which three educational games were designed based on the principles of environmental education and game-based learning. The materials were developed from scientific information on native snake species, pedagogically adapted, and implemented during environmental education workshops with middle and high school students. The activities addressed fear and misconceptions surrounding snakes, emphasizing their ecological importance while encouraging students' active participation. The use of the games facilitated the integration of scientific knowledge with playful learning experiences, promoting greater engagement, learning, and awareness of snake conservation. The findings highlight the potential of educational games as an effective methodological strategy for environmental education, contributing to the deconstruction of stereotypes, the development of conservation-oriented attitudes, and the appreciation of biodiversity.

Keywords: educational games. environmental education. Herpetology. snake conservation. playful learning.

Resumo: Este estudo teve como objetivo desenvolver e aplicar jogos educativos como ferramenta para o ensino de herpetologia e a promoção da conservação de serpentes em escolas do Rio Grande do Sul. Trata-se de um estudo de caráter aplicado, desenvolvido no âmbito do projeto de extensão *Serpentes na Escola*, no qual foram elaborados três jogos didáticos fundamentados em princípios da educação ambiental e do ensino lúdico. Os materiais foram construídos a partir da seleção de conteúdos científicos sobre espécies nativas, adaptados pedagogicamente e aplicados em oficinas de educação ambiental destinadas a estudantes do ensino fundamental II e do ensino médio. As atividades buscaram abordar o medo e os preconceitos associados às serpentes, enfatizando sua importância ecológica e estimulando a participação ativa dos estudantes. A utilização dos jogos favoreceu a integração entre conhecimentos científicos e práticas lúdicas, promovendo maior engajamento, aprendizagem e sensibilização para a conservação desses animais. Os resultados evidenciam o potencial dos jogos educativos como estratégia metodológica para a educação ambiental, contribuindo para a desconstrução de estereótipos, o desenvolvimento de atitudes conservacionistas e a valorização da biodiversidade.

Palavras-chave: jogos educativos. educação ambiental. Herpetologia. conservação de serpentes. ensino lúdico.

Resumen: Este estudio tuvo como objetivo desarrollar e implementar juegos educativos como herramienta para la

enseñanza de la herpetología y la promoción de la conservación de las serpientes en escuelas de Rio Grande do Sul, Brasil. Se trata de un estudio de carácter aplicado, desarrollado en el marco del proyecto de extensión *Serpentes na Escola (Serpientes en la Escuela)*, en el que se diseñaron tres juegos didácticos basados en los principios de la educación ambiental y del aprendizaje lúdico. Los materiales fueron elaborados a partir de información científica sobre especies nativas de serpientes, adaptados pedagógicamente y aplicados en talleres de educación ambiental dirigidos a estudiantes de educación secundaria básica y media. Las actividades buscaron abordar el miedo y los prejuicios asociados a las serpientes, destacando su importancia ecológica y fomentando la participación activa de los estudiantes. El uso de los juegos favoreció la integración del conocimiento científico con experiencias de aprendizaje lúdicas, promoviendo un mayor compromiso, aprendizaje y sensibilización hacia la conservación de estos animales. Los resultados ponen de manifiesto el potencial de los juegos educativos como una estrategia metodológica eficaz para la educación ambiental, contribuyendo a la deconstrucción de estereotipos, al desarrollo de actitudes favorables a la conservación y a la valoración de la biodiversidad.

Palabras-clave: juegos educativos. educación ambiental. herpetología. conservación de serpientes. aprendizaje lúdico.

1 INTRODUCTION

Biodiversity conservation is both an urgent concern and a global necessity, and environmental education represents a fundamental approach to fostering understanding and appreciation of the diverse forms of life that inhabit the planet. In the search for effective solutions to the environmental challenges faced by ecosystems, environmental education plays a crucial role in raising awareness and engaging present and future generations in biodiversity conservation (Valgas *et al.*, 2022, 2024). A clear reflection of the lack of knowledge and the disconnect (gap) between society and the natural environment can be observed in the case of snakes, which often occupy a misunderstood and even feared place in the public imagination. Snakes are organisms that are subject to numerous negative stereotypes and prejudices, largely resulting from misinformation, fear, and limited contact with this group. Nevertheless, they are essential for maintaining ecosystem balance, playing vital roles in food webs and pest control, while also providing bioactive compounds that can be used in pharmaceutical development. Therefore, environmental education focused on snake conservation is essential for promoting harmonious coexistence between humans and these animals. It contributes to improving ecoliteracy and encouraging behavioral changes, including greater commitment to conservation and the strengthening of social cohesion and trust (Lee *et al.*, 2021).

The importance of environmental education for snake conservation is supported by scientific evidence. In a study conducted by Shine (2010), it was highlighted that negative perceptions of snakes are often based on myths and a lack of understanding of their ecology and behavior. Through education, these misconceptions can be addressed, fostering more accurate and positive perceptions of these animals. Reed *et al.* (2017) demonstrated that educational programs about snakes can significantly increase public knowledge regarding their ecological importance and the benefits of their presence in ecosystems. Such programs not only help dispel unfounded fears of snakes but also encourage more favorable attitudes toward their conservation. Another important aspect is the role of snakes as indicators of environmental health. As noted by Gibbons *et al.* (2000), changes in snake abundance and distribution within an ecosystem may indicate significant shifts in ecological balance, serving as early warning signs of environmental disturbances that affect not only snakes but the entire biological community.

The importance of games in environmental education, particularly with regard to species conservation,

is supported by a growing body of research. Hughey, Krogh, and McDougall (2011) demonstrated that games can significantly enhance players' knowledge of environmental issues as well as their willingness to engage in conservation actions. Similarly, Coad *et al.* (2010) showed that games can play a fundamental role in changing environmental attitudes and behaviors by encouraging the adoption of sustainable practices and fostering appreciation for biodiversity.

In this context, games have emerged as a promising and engaging strategy for promoting awareness of species and habitat conservation (Valgas *et al.*, 2024). As highlighted by Barata, Gama, Jorge, and Gonçalves (2010), "games have the potential to engage players in an immersive way, allowing them to explore and understand complex concepts through interactive and enjoyable experiences." In recent years, games have become a powerful and effective educational tool, attracting the attention of educators, researchers, and parents alike. The growing popularity of games in education is far from coincidental; rather, it is grounded in robust scientific evidence demonstrating the significant benefits they offer to the learning process (Gregol *et al.*, 2021). As Gee (2003) argues, "games are, at their core, problem-solving systems," thereby providing immersive and dynamic learning environments in which learners are actively engaged in developing cognitive, social, and emotional skills. Likewise, Prensky (2001) demonstrated that games can enhance students' intrinsic motivation, increasing both their engagement and interest in educational activities.

The activities described in this study were developed within the framework of the *Serpentes na Escola* ("Snakes at School") extension project, affiliated with the **Federal University of Rio Grande do Sul (UFRGS)**. The project aims to promote environmental education and science communication on the biology, ecology, and conservation of snakes, with the goal of dispelling myths and prejudices historically associated with these animals. Through workshops, educational games, and teaching materials designed for school communities, the project seeks to bridge the gap between scientific knowledge and students' everyday experiences, fostering an understanding of the ecological importance of snakes, promoting the prevention of snakebite accidents, and encouraging attitudes that support biodiversity conservation.

Accordingly, the objective of this study is to develop interactive educational games aimed at raising awareness and promoting education about snake conservation. Specifically, the study seeks to foster affective and socio-environmental connections within the school community, emphasize the ecological importance of snakes, and develop educational initiatives designed to reduce the risk of snakebite accidents as well as the unjustified killing of these organisms.

2 MATERIALS AND METHODS

The present study is characterized as applied research with a qualitative approach, aimed at the development of educational games for teaching ophiology and environmental education. Three educational games were designed to promote interest, meaningful learning, and changes in students' perceptions of snakes among upper elementary (middle school) and secondary school students. The methodological framework was grounded in critical environmental education and game-based learning approaches, integrating scientific knowledge, socio-environmental awareness, and active student participation.

The games were developed within the framework of the *Serpentes na Escola* ("Snakes at School") extension project, which seeks to dispel misconceptions about snakes and promote awareness of their ecological importance. At this stage of the study, the games were pilot-tested with a sixth-grade elementary school class consisting of 30 students to assess the clarity of the rules, the usability of the materials, and their pedagogical suitability. No systematic evaluation of the educational effectiveness of the intervention was conducted during this preliminary phase.

The educational activities were implemented through pedagogical workshops organized as part of the *Serpentes na Escola* extension project. These workshops were designed not only to challenge misconceptions regarding snakes but also to increase awareness of their ecological significance, particularly their role in regulating prey populations and maintaining ecosystem balance.

2.1 Game Development Process

The development of the educational materials followed four main stages.

1. Selection of Scientific Content

Initially, native snake species occurring in the state of Rio Grande do Sul were selected, with particular emphasis on species recorded in the Greater Porto Alegre region. For each species, relevant biological and ecological information—including scientific name, body size, diet, defensive behavior, and level of medical importance—was compiled. The information was selected and adapted to ensure accessibility for the target audience while maintaining scientific accuracy.

2. Pedagogical Adaptation

The scientific content was translated into accessible language and incorporated into game-based learning activities following the principles of meaningful learning and active learning methodologies. Particular attention was given to balancing scientific rigor with communicative clarity, thereby facilitating conceptual understanding while promoting student engagement.

3. Graphic Design and Material Production

The graphic design and layout of the educational games were developed using the Canva Edu platform, enabling the production of visually attractive game cards and standardized educational materials. Authentic photographs of the snake species, provided by collaborators of the extension project, were incorporated to ensure visual accuracy and enhance students' ability to recognize the species.

4. Institutional Collaboration and Image Validation

For species belonging to the family *Viperidae*, both the photographic material and taxonomic identifications were validated by researchers Samuel Ferreira Gohlke and Laura Verrastro from the Herpetology Laboratory at the Federal University of Rio Grande do Sul (UFRGS). Their collaboration ensured accurate species identification and the use of scientifically reliable images, thereby strengthening the technical quality and scientific credibility of the educational materials.

2.2 Educational Workshops

The games were implemented during environmental education workshops conducted in school settings by

members of the extension project. Each workshop was organized into three sequential phases:

- **Initial phase (diagnosis and awareness):** assessment of students' prior perceptions of snakes, including fears, beliefs, and previous knowledge;
- **Core phase (game-based intervention):** use of the educational games as the primary instructional tool for knowledge mediation;
- **Final phase (discussion and reflection):** group discussion of the learning experience, clarification of questions, and critical reflection on ecological and conservation-related issues.

2.3 Target Audience and Methodological Approach

The educational games were designed for use with students in upper elementary (middle school) and secondary education, with the content and instructional strategies tailored to these educational levels. However, at this stage of the study, the materials were pilot-tested with 30 sixth-grade students from a public school participating in the *Serpentes na Escola* extension project. The class was selected by convenience based on the school's availability and the feasibility of conducting the pilot implementation. The primary objective of this pilot test was to evaluate students' comprehension of the game rules, the practical applicability of the materials, and their pedagogical suitability.

The methodological approach emphasized active student participation, collaborative learning, and experiential learning, in accordance with contemporary perspectives in environmental education and science education.

3 RESULTS

Three educational games—Snake Battle (*Cobra Combate*), Predator–Prey (*Presa–Predador*), and Memory Game: Snakes of Rio Grande do Sul (*Jogo da Memória – Serpentes do Rio Grande do Sul*)—were developed and implemented during environmental education workshops conducted as part of the *Serpentes na Escola* extension project. The use of these games enabled the integration of scientific knowledge on herpetology with game-based educational practices, promoting an active, participatory, and context-based learning experience.

Snake Battle (*Cobra Combate*)

Objective

The objective of the game is to collect all the cards in the deck by winning head-to-head comparisons based on the biological attributes of native snake species occurring in the state of Rio Grande do Sul, particularly those found in the Porto Alegre Metropolitan Region (Greater Porto Alegre, GPA).

Game Components

The deck consists of 20 playing cards, each representing a native snake species recorded in the Greater Porto Alegre region. Each card contains biological and ecological information about a single species (Fig. 1), including:

- Common and scientific names;
- Photograph of the species;

- Maximum body length (cm);
- Diet (different prey categories comprising the species' diet);
- Danger level, ranked on a scale from 1 to 5, based on the presence of medically significant venom and the species' defensive aggressiveness;
- Number of defensive behaviors, accompanied by descriptions of the behavioral displays exhibited when the animal perceives a threat.

Figure 1. Examples of the game cards used in Snake Battle (*Cobra Combate*) and illustration of the game's mechanics.



Source: Prepared by the authors (2026).

Game Dynamics

1. Shuffle the deck thoroughly.
2. Deal all cards equally among the players.
3. Each player keeps their cards in a single face-down pile without looking at them.

Game Rules

1. Beginning the Game

- The player to the dealer's left starts the first round.
- This player chooses one category for comparison: **Maximum Body Length, Diet, Danger Level, or Defensive Behaviors.**

2. Card Comparison

- All players reveal the top card from their piles simultaneously and compare the values in the selected category.
- The player with the highest value in the chosen category wins the round and collects all the revealed cards, placing them face down at the bottom of their pile.

3. Tie

- In the event of a tie, the contested cards are placed face down in the center of the table.
- A new comparison is initiated by the same player who selected the category in the previous round.
- The winner of the subsequent round collects all contested cards, including those placed in the center.

4. Special Categories

- **Danger Level:** Ranked on a five-point scale, where **1** represents the lowest level of danger and **5** the highest, based on the presence of medically significant venom and species aggressiveness.
- **Defensive Behaviors:** If two cards tie in the number of defensive behaviors, the card containing the most comprehensive and detailed behavioral description is considered the winner. When necessary, players may reach a consensus or consult a reference guide.

5. Super Trump Card

- Each deck contains one special **Super Trump** card, which automatically defeats every other card regardless of the selected category, except when played against another Super Trump card.
- The Super Trump card may only be used when it is the top card in a player's pile and is revealed during a round.
- A player who retains only the Super Trump card after losing all remaining cards is eliminated from the game.

6. End of the Game

The game ends when one player has collected all the cards in the deck and is declared the winner.

Predator–Prey (Presa–Predador)

Objective

The objective of the game is to encourage collaborative learning by having players work together to correctly match each snake species with its respective prey, thereby exploring the diversity of feeding habits among native snakes.

Game Components

The game consists of a deck of **six large cards**, divided into two categories (Fig. 2):

- **Predator cards:** Each card represents a native snake species from Rio Grande do Sul occurring in the Greater Porto Alegre region and includes a photograph together with its common and scientific names.
- **Prey cards:** Each card contains photographs illustrating the potential prey items consumed by the corresponding snake species.

Game Setup

1. Shuffle the predator and prey cards separately.

2. Place both sets face down in the center of the table, with predator cards on one side and prey cards on the other.

Game Rules

1. Beginning the Game

- The game is played cooperatively.
- The group selects the first player, who turns over one predator card and one prey card.

2. Matching

- If the two revealed cards form a correct predator–prey association, the player removes the pair from the table and the group earns one point.
- If the cards do not match, they are returned face down to their original positions.

3. Turns

- The next player, chosen by the group, reveals another pair of cards.
- Play continues until all predator and prey cards have been correctly matched.

End of the Game

The game ends when all predator and prey pairs have been successfully identified.

Figure 2. Diagram illustrating representative game cards and the gameplay mechanics of the *Predator–Prey (Presa–Predador)* educational game.



Source: Prepared by the authors (2026).

Memory Game – Snakes of Rio Grande do Sul (*Jogo da Memória – Serpentes do Rio Grande do Sul*)

Objective

The objective of the game is to match identical pairs of cards and collect as many pairs as possible. Each pair represents a native snake species occurring in the state of Rio Grande do Sul, specifically those found in the Greater Porto Alegre Metropolitan Region.

Game Components

- A deck containing **12 pairs of cards** (24 cards in total), with each pair representing a native snake species recorded in the Greater Porto Alegre region (Fig. 3).
- Each card includes:
 - Common name of the snake;
 - Scientific name of the snake;
 - Photograph of the species.

Game Setup

1. Shuffle all cards thoroughly.
2. Arrange the cards face down in a rectangular grid (e.g., 6×4 , according to the total number of cards).

Game Rules

1. Beginning the Game

- The youngest player takes the first turn.
- Play proceeds clockwise.

2. Gameplay

- During each turn, the player flips over two cards of their choice so that all participants can see the photographs and species names.
- If the two revealed cards are identical (i.e., they represent the same snake species), the player collects the pair, earns one point, and immediately takes another turn.
- If the cards do not match, they are turned face down again in their original positions, and play passes to the next participant.

3. End of the Game

- The game ends when all pairs have been successfully matched.
- The player who has collected the greatest number of pairs is declared the winner.

Figure 3. Diagram illustrating representative cards used in the Memory Game – Snakes of Rio Grande do Sul (*Jogo da Memória – Serpentes do Rio Grande do Sul*).



Source: Prepared by the authors (2026).

4 DISCUSSION

The use of educational games in formal education has become an increasingly recognized and innovative pedagogical strategy, particularly in environmental education and herpetology, fields that are often shaped by cultural, emotional, and cognitive barriers associated with fear and misinformation. Within this context, the findings of the *Serpentes na Escola* ("Snakes at School") project demonstrate that incorporating game-based activities into structured educational workshops not only facilitates knowledge acquisition but also promotes the re-evaluation of historically negative perceptions associated with snakes.

Previous studies have shown that game-based learning enhances students' cognitive and emotional engagement by stimulating sustained attention, intrinsic motivation, and active participation. Barata et al. (2010) argue that educational games are particularly effective in engaging students who are traditionally less motivated because they introduce progressive challenges and immediate feedback, two essential components for developing critical thinking skills. Similar patterns were observed in the present study, during which students exhibited high levels of participation, peer interaction, and sustained interest throughout the workshops, suggesting that the games functioned as effective facilitators of engagement.

The **Snake Battle (Cobra Combate)** game, in particular, illustrates the effectiveness of learning through comparison- and competition-based mechanics. By requiring players to compare biological attributes such as body size, diet, danger level, and defensive behaviors, the game stimulates higher-order cognitive processes including analysis, classification, and decision-making, closely resembling authentic scientific practices. Furthermore, the repeated comparison of cards reinforces long-term memory consolidation, as predicted by

cognitive learning theories. The incorporation of visual and symbolic elements, such as icons representing diet and danger level, also provides important semiotic support, facilitating the understanding of abstract and complex biological concepts.

These findings are consistent with those of Canto and Zacarias (2009), who highlighted the value of card games for organizing and retaining scientific information. In the present study, students progressively recognized ecological patterns, including the association between venomous species and higher danger rankings, as well as the diversity of defensive strategies exhibited by different snake species. Such observations suggest that the learning process extended beyond simple memorization toward the development of meaningful conceptual understanding.

The educational approach adopted in this study is also supported by Chen (2018), who discussed the role of games in fostering pro-conservation attitudes. Although Chen's work focused primarily on digital games, the present findings demonstrate that analog educational games, when integrated into well-structured educational workshops, possess comparable potential for promoting environmental awareness. The direct interaction among students, facilitators, and educational materials created opportunities for collaborative knowledge construction, a central principle of constructivist learning approaches (Valgas *et al.*, 2022).

Similarly, Efthimiou and Tucker (2021) argue that educational games facilitate the pedagogical transposition of complex scientific concepts into forms that are accessible to younger learners. This aspect was particularly evident in the complementary use of the **Snake Battle** and **Predator–Prey (*Presa–Predador*)** games, which enabled students to explore advanced ecological concepts such as dietary specialization and generalism. By analyzing dietary attributes within the games, students were able to infer ecological relationships without requiring prior formal instruction, highlighting the value of game-based activities as tools for conceptual mediation.

Another important aspect concerns the role of educational workshops as environments for active learning. Studies by Valgas *et al.* (2024) and Gregol *et al.* (2021) have demonstrated that practical, interactive activities are fundamental for increasing student engagement and facilitating the internalization of environmental concepts. In the present study, the workshops functioned as collaborative learning environments in which the educational games served as catalysts for discussion, allowing participants to critically examine topics such as snakebite prevention, the ecological importance of snakes, and biodiversity conservation. Throughout the activities, students demonstrated a gradual shift from an initial perception largely characterized by fear toward a more informed, critical, and scientifically grounded understanding of snakes.

According to Gee (2007), effective educational games function as problem-solving systems in which learning emerges through interaction with meaningful, contextualized challenges. This characteristic was clearly reflected in **Snake Battle**, which requires players to interpret biological information and make strategic decisions, and in **Predator–Prey**, which promotes ecological reasoning through the construction of trophic relationships. In turn, the **Memory Game – Snakes of Rio Grande do Sul** contributed to the development of visual recognition skills and attention to morphological characteristics, competencies that are fundamental in biological sciences, particularly in taxonomic identification.

The repeated exposure to visual stimuli and the recognition of species-specific patterns required by the memory game resemble cognitive processes involved in perceptual learning, an essential component of field biology and species identification. Consequently, the game extends beyond reinforcing factual knowledge by fostering important scientific competencies, including careful observation, visual discrimination, and biological classification.

Finally, the results indicate that the incorporation of educational games into environmental education workshops produces impacts that extend beyond cognitive learning to include attitudinal and behavioral dimensions. Students' increased ability to recognize venomous species and understand their ecological roles has direct implications for reducing practices such as the indiscriminate killing of snakes, which is frequently driven by fear and misinformation. Consequently, these games represent strategic educational tools not only for teaching scientific concepts but also for fostering a conservation-oriented mindset and promoting more harmonious coexistence between humans and biodiversity.

Overall, the findings of this study reinforce that educational games, when combined with well-mediated pedagogical practices, constitute a theoretically grounded and pedagogically effective approach for teaching herpetology and promoting environmental education. The results are consistent with the broader literature on game-based learning and suggest promising directions for future educational interventions and research on biodiversity conservation.

4 CONCLUSIONS

The use of educational games, such as those presented in this study, within the context of environmental education workshops represents an effective and engaging strategy for teaching herpetology and raising awareness of the ecological importance of snakes. These games not only provide an interactive and enjoyable learning experience but also play a crucial role in dispelling misconceptions, prejudices, and fears historically associated with these animals. Through educational game cards containing detailed information about native snake species from Rio Grande do Sul, students are encouraged to explore and understand the ecology, behavior, and ecological significance of snakes. This approach fosters stronger emotional and socio-environmental connections within the school community, emphasizing the essential role that snakes play in maintaining ecosystem functioning and contributing to the conservation of these species.

Furthermore, incorporating game-based activities into school curricula, particularly through environmental education workshops, creates a more dynamic and motivating learning environment. This approach not only enhances student engagement but also facilitates the understanding of complex scientific concepts in an enjoyable and memorable manner. Consequently, the implementation of educational games as tools for snake conservation education represents a promising pedagogical approach that should be further encouraged and expanded. By promoting positive changes in knowledge, attitudes, and behaviors toward snakes, such initiatives can contribute to fostering greater appreciation of their ecological roles and to strengthening broader biodiversity conservation efforts.

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Conflict of Interest

The authors declare that they have no conflicts of interest. All authors have read and approved the manuscript and are aware of its submission for publication.

Author Contributions

Artur Antunes Navarro Valgas: Conceptualization and development of the educational games; writing of the manuscript; Samuel Ferreira Gohlke: Conceptualization and development of the educational games; writing of the manuscript; Gustavo Kasper Cubas: Conceptualization and development of the educational games; writing of the manuscript; Michele Esperança: Conceptualization and development of the educational games; writing of the manuscript; Diogo Reis de Oliveira: Conceptualization and development of the educational games; writing of the manuscript; Amanda Severo Rossa: Conceptualization and development of the educational games; writing of the manuscript; Bianca Ferreira Aveline: Conceptualization and development of the educational games; writing of the manuscript; Laura Verrastro: Conceptualization and development of the educational games; writing of the manuscript; project supervision and coordination; Mariana Bragischi da Silva: Conceptualization and development of the educational games; writing of the manuscript.

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