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Article

EDUCATIONAL GAMES FOR TEACHING SCIENCE IN MIDDLE SCHOOL: AN INTEGRATIVE REVIEW

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ABSTRACT

Given the contemporary challenges of science education, active learning methodologies present themselves as a teaching strategy aimed at promoting greater student engagement, thereby making the teaching-learning process more meaningful. Within this context, play-based games emerge as didactic strategies that combine playfulness, interaction, and the collective construction of knowledge. Accordingly, the present study aimed to conduct a survey of the main play-based games applicable to middle school (Ensino Fundamental Anos Finais) for teaching Biology content. The research is characterized as an integrative review, developed through searches in the Portal Periódicos CAPES and Google Scholar databases,

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covering publications from 2019 to 2026. A total of 1,669 articles were identified, of which, after the screening stages and application of inclusion and exclusion criteria, only 13 composed the final sample for analysis. The results evidenced the use of physical games, such as board and card games, dice, and dominoes, addressing content in Zoology, Ecology, Cell Biology, Botany, Physiology, and Genetics. The analyzed studies indicate that games foster engagement, active participation, and the consolidation of scientific concepts, in addition to enabling diagnostic assessment when developed under teacher mediation. In times of unmotivated students and screens competing with the blackboard, playfulness presents itself not as an alternative, but as a necessity. The results of this study prove it: when students play, they do not just learn Biology, they live Biology. And what is lived is not forgotten. Investing in educational games is, therefore, investing in a more humane, active, meaningful, and innovative science education.

Keywords: Science Education; Active Methodologies; Pedagogical Practices; Educational Games.

RESUMEN

Ante los desafíos contemporáneos en la enseñanza de las Ciencias de la Naturaleza, las metodologías activas se presentan como una estrategia que busca promover la participación de los estudiantes y hacer más significativo el proceso de enseñanza-aprendizaje. En este contexto, los juegos surgen como estrategias didácticas que unen ludicidad, interacción y construcción colectiva del conocimiento. Por ello, el presente estudio tuvo como objetivo realizar un relevamiento de los principales juegos aplicables a los años finales de la Enseñanza Fundamental (Ensino Fundamental Anos Finais), orientados a la enseñanza de contenidos de Biología. La investigación se caracteriza como una revisión integrativa, desarrollada a partir de búsquedas en las bases de datos Portal de Periódicos CAPES y Google Académico, que abarcaron publicaciones del período de 2019 a 2026. Se identificaron 1669 artículos, de los cuales, tras las etapas de cribado y la aplicación de los criterios de inclusión y exclusión, solo 13 conformaron la muestra final de análisis. Los resultados evidenciaron el uso de juegos físicos, como tableros y cartas, dados y dominó, que abarcan contenidos de Zoología, Ecología, Biología Celular, Botánica, Fisiología y Genética. Los estudios analizados indican que los juegos favorecen el compromiso, la

participación activa y la consolidación de conceptos científicos, además de posibilitar la evaluación diagnóstica cuando se desarrollan bajo mediación docente. En tiempos de estudiantes desmotivados y pantallas que compiten con la pizarra, lo lúdico se presenta no como una alternativa, sino como una necesidad. Los resultados demuestran que, cuando el estudiante juega, no solo aprende Biología, sino que la vive. Lo que se vive no se olvida. Invertir en juegos didácticos es, por tanto, invertir en una educación científica más humana, activa, significativa e innovadora.

Palabras clave: Enseñanza de las Ciencias; Metodologías activas; Prácticas pedagógicas; Juegos didácticos.

RESUMO

Diante dos desafios contemporâneos no ensino de Ciências da Natureza, as metodologias ativas apresentam-se como uma estratégia que visa promover o envolvimento dos estudantes, tornando o processo de ensino-aprendizagem mais significativo. Neste contexto, os jogos surgem como estratégias didáticas que unem ludicidade, interação e construção coletiva do conhecimento. Diante disso, o presente estudo teve como objetivo realizar um levantamento dos principais jogos aplicáveis ao Ensino Fundamental Anos Finais voltados ao ensino de conteúdos de Biologia. A pesquisa se caracteriza como uma revisão integrativa, desenvolvida a partir de buscas nas bases de dados Portal Periódicos CAPES e Google Acadêmico abrangendo publicações no período de 2019 a 2026. Foram identificados 1.669 artigos, dos quais, após as etapas de triagem e aplicação dos critérios de inclusão e exclusão, somente 13 compuseram a amostra final de análise. Os resultados evidenciaram a utilização de jogos físicos, como tabuleiros e cartas, dados e dominó, contemplando conteúdos de Zoologia, Ecologia, Biologia Celular, Botânica, Fisiologia e Genética. Os estudos analisados indicam que os jogos favorecem o engajamento, a participação ativa e a consolidação de conceitos científicos, além de possibilitarem avaliação diagnóstica quando desenvolvidos sob mediação docente. Em tempos de estudantes desmotivados e telas competindo com o quadro, o lúdico se apresenta não como alternativa, mas como necessidade. Os resultados comprovam: quando o estudante joga, ele não apenas aprende Biologia, ele vive a Biologia. Aquilo que se vive, não se esquece. Investir em jogos didáticos é, portanto, investir em uma educação científica mais humana, ativa, significativa e inovadora.

Palavras-chave: Ensino de Ciências; Metodologias ativas; Práticas pedagógicas; Jogos didáticos.

1 INTRODUCTION

Active Learning Methodologies (ALMs) are pedagogical practices that place students at the center of the teaching and learning process, while teachers act as mediators and facilitators. Thus, this approach emerges as an alternative to the traditional teaching model. It promotes a transformative and up-to-date education that fosters reflective, creative, and autonomous students who take ownership of their own learning (Cunha et al., 2024; Santos and Castaman, 2022).

Gamification is an active learning methodology that applies game logic, mechanics, and problem-posing to the classroom. Unlike simply playing a game, gamification turns the teaching and learning process into a more motivating, interactive, and effective experience (Maia, 2023). In Biology teaching, this resource has proved effective in stimulating student interest, facilitating content retention, and promoting active participation, in line with the principles of active learning (Pantoja et al., 2022).

Games are ludic activities that are important for social, moral, and cognitive development, and they are indispensable to pedagogical practice (Mendes and Gomides, 2020). They add a practical dimension that supports the understanding of content by turning abstract concepts into situations experienced by students. They also create scenarios that require analysis, decision-making, and argumentation, thereby stimulating cognitive skills that traditional practices usually do not engage (Acrani et al., 2020).

In Maranhão, the teaching of Biology content in middle school (Ensino Fundamental) faces significant challenges. The main one is the difficulty of engaging students in content that is often presented in an abstract way, detached from their everyday reality. In this context, renewing pedagogical practices through new methodologies has become increasingly necessary. Among these methodologies, games stand out as a relevant teaching resource, because they combine playfulness with student interaction. They favor meaningful learning that is not always achieved with textbooks and lecture-based classes alone (Conceição et al., 2020). Games also contribute to United Nations Sustainable Development Goal (SDG) 4 (Quality Education), which advocates inclusive and equitable education

capable of promoting meaningful, high-quality learning opportunities for all students (United Nations, 2015; Serra et al., 2026).

Therefore, this study aimed to survey the main educational games used in middle school (Ensino Fundamental Anos Finais, Grades 6 to 9) for learning Biology content within the Sciences. It also sought to investigate the contributions of playfulness through games to the teaching of scientific concepts, identifying their potential to mediate between theory and practice and to promote student interest and motivation.

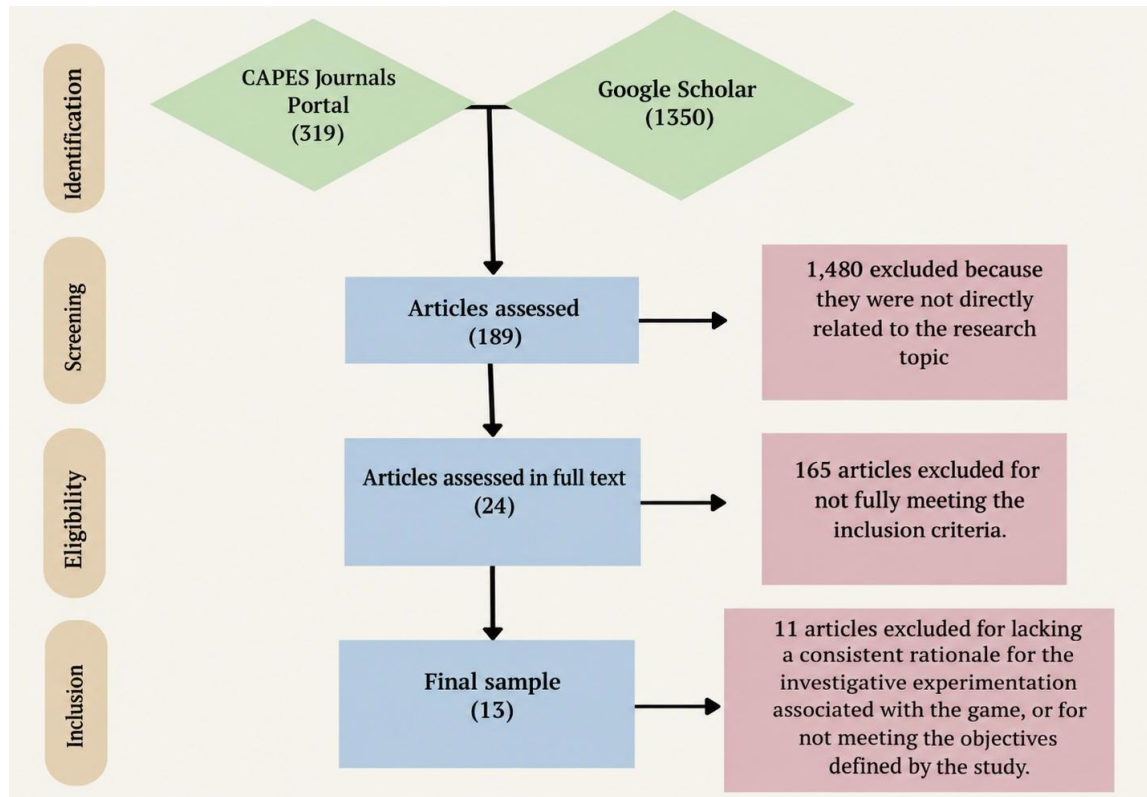
2 METHODOLOGY

This is an integrative literature review. This method gathers and synthesizes the knowledge produced on a given topic and favors the incorporation of study findings into practice. It is considered the broadest type of review, because it admits studies with different methodological designs and provides a more complete understanding of the phenomenon (Souza et al., 2010).

The search was conducted in the CAPES Journals Portal and Google Scholar databases and covered the period from 2019 to 2026. The search terms were "Investigative Experiment," "Ludic," "Games," "Pedagogical Practices," "Middle school," "Biology," and "Science," combined with the Boolean operators AND and OR.

Regarding selection, full-text articles in Portuguese, English, and Spanish were included if they addressed educational games in the teaching of Science or Biology in middle school. Duplicate studies were excluded, as were studies outside the time frame, studies without access to the full text, and studies unrelated to the topic, as shown in the flowchart (Figure 1).

The selected studies were organized in a spreadsheet with authorship, year, objective, type of game, content addressed, and main results. The data were analyzed to identify methodological procedures, pedagogical contributions, and relationships between theory and practice.

Figure 1. Flowchart of article selection

Source: The authors (2026).

2.1 Funding

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2.2 Statement on the Use of AI

The artificial intelligence tool Claude (Anthropic, model Claude Sonnet 5.5) was used to support language revision and the standardization of bibliographic references. The authors reviewed all content produced with the support of the tool. They take full responsibility for the text, the accuracy of the information, and the citations.

3 RESULTS AND DISCUSSION

The search returned 1,669 articles. After the inclusion and exclusion criteria were applied, 13 made up the final analysis. The corpus included analog games, such as board games, card games, dominoes, and dice games, designed for teaching Biology in middle school. Board games predominated, appearing in ten studies, whereas card, domino, and dice formats were each described in only one study.

As to content, the games covered several areas of Biology, with the greatest concentration in Zoology (five articles), Ecology (three articles), and Cell Biology (two articles). The other areas addressed, such as Botany, Physiology, and Genetics, had one publication each.

Regarding publication year, the largest concentration was in 2020, with four publications, followed by 2021, with three. The years 2019 and 2025 had two studies each, and 2022 and 2023 had one each. No publications were recorded in 2024 and 2026. Table 1 lists the games with authorship, year, and type of game.

Table 1. Distribution of educational games in Science teaching in middle school (Ensino Fundamental Anos Finais)

Game Title	Game Format	Subject Area	Reference
Batalha Viral: combatendo o <i>Aedes aegypti</i>	Board game	Zoology/ Human Health	Ryzy and Crisostimo, 2020
Trilha Botânica	Board game	Botany	Costa et al., 2019
Procarionte Profile	Board game	Cytology	Caetano and Pereira, 2020
Jogo do DNA	Board game	Genetics	Travessas et al., 2020
Qual é o bicho?	Board game	Zoology	Dias and Chacur, 2019
Guardiões da Biodiversidade	Board game	Ecology	Schultz et al., 2021
Sangue que salva	Dice game	Physiology	Sousa et al., 2022
Descobrimos os artrópodes	Board game	Zoology	Teles, 2020

Explorando Biomas	Board game	Ecology	Barbosa and Sun, 2025
Dominó Cnidários	Domino game	Zoology	Silva and Carvalho, 2021
Trilha dos répteis	Board game	Zoology	Oliveira and Oliveira, 2021
Oikos	Card game	Ecology	Santos and Bastos, 2025
Tabuleiro da Célula	Board game	Cytology	Oliveira et al., 2023

Source: The authors (2026).

3.1 Question-and-answer board games

Seven games use the board as their structure and make participants' progress conditional on correct answers to conceptual questions. In all of them, the game revisits content previously covered in class.

The first of these, "Batalha Viral: combatendo o *Aedes aegypti*" (Ryzy and Crisostimo, 2020), consists of a 60-space board, six pawns, one die, twenty question cards, an answer sheet, and a rulebook. The activity is carried out in teams of three to six members. A leader chosen in each group is responsible for checking the answers. Spaces marked with a question mark require the group to answer orally a question drawn from a card. A correct answer grants movement commands, whereas a wrong answer brings penalties, such as moving back one space or skipping a turn. The remaining spaces display illustrations on preventing the proliferation of the vector, also accompanied by commands to follow. Overall, the content reviewed covers the morphology, habits, breeding sites, and diseases transmitted by the mosquito.

A similar structure is found in "Trilha Botânica" (Costa et al., 2019), with a 40-space path, and dice and pegs made from recycled material. Four teams take part, each represented by one member who rolls the die and moves the peg. Progress during the game occurs when the team correctly answers the question on the space where it stopped. The color of the spaces

on the board indicates their function: general questions on the theme, challenges, moving forward, curiosities in a "Did you know?" format, moving back, and losing a turn. The content is distributed in four thematic blocks: vegetative organs, reproductive organs, botanical groups, and everyday uses of plants.

In turn, the "Jogo do DNA" (Travessas et al., 2020) is intended for reviewing concepts of Cytology and Evolution, linked to the history of the discovery of DNA. The board reproduces the double helix structure and has 25 question cards and 25 curiosity cards. The activity allows individual participation, or participation in pairs, trios, or groups of up to five members. Question-mark spaces draw conceptual questions, and spaces marked with the letter "C" draw historical curiosities, whose text determines moving forward or backward. On ordinary spaces, the turn simply passes to the next participant. According to the authors, when in doubt, the other participants could help their peer, which fostered collective review of the content.

In another format, the "Trilha dos Répteis" (Oliveira and Oliveira, 2021) consists of a large board laid out on the classroom floor, with 34 spaces, a giant die, three cones representing the teams, and 30 question cards, written as true-or-false and multiple-choice items. The board contains images of crocodilians, chelonians, and squamates, which link the knowledge discussed to visual representations. In each round, the team answers a question. When it answers correctly, it keeps the turn and rolls the die to determine how many spaces to move. When it answers incorrectly, the opportunity passes to the next group. In this way, progress along the path is directly related to mastery of the content. In addition to revisiting knowledge about reptiles, the game fosters interaction and information exchange among students.

In turn, the game "Guardiões da Biodiversidade" (Schultz et al., 2021) is based on the Ludo model and addresses the fauna, flora, and conservation of the Atlantic Forest. The goal is to be the first to reach the center of the board, following the arrows according to the number rolled on the die. Along the path, some spaces carry a question mark and draw one of two types of card. Question-and-answer cards present multiple-choice questions on the diversity of living beings. Challenge cards convey information and curiosities about endangered species, with effects ranging from moving forward to losing a turn. The proposal seeks to lead students to learn about biodiversity and to reflect on its preservation in a playful way, relating scientific content to the environmental issues of the biome.

Also with an environmental theme, "Explorando Biomas" (Barbosa and Sun, 2025) uses a map of Brazil as the board, and the path extends from Rio Grande do Sul to Acre. The material comprises 54 question cards on the fauna, flora, climate, and ecological characteristics of the biomes, as well as 27 wild cards, which introduce challenges and alter the route. On reaching each state, the participant answers a question about the predominant biome in the region. If the player answers correctly, they stay in place. If they answer incorrectly, they may go back the same number of spaces they have advanced so far. The authors report that the game aroused interest and interaction, although students' difficulties in reading and interpreting the questions required the teacher's mediation.

Closing this category, the "Tabuleiro da Célula" (Oliveira et al., 2023) is a complementary resource for teaching Cell Biology, with emphasis on the structure and functions of cells. The board represents an animal cell, organized in tracks, and the material includes 50 question-and-answer cards illustrated with organelles. Three groups of four or five members take part in the activity. A member of another team reads the question. A correct answer keeps the group on its space and earns it points, whereas an incorrect answer means moving back and losing points.

3.2 Board games based on deduction from clues

Unlike the previous ones, three board games replace the direct question with the gradual identification of an answer from partial information, called clues, over the course of the match.

Among them, "Procarionte Profile" (Caetano and Pereira, 2020) is inspired by the commercial game "Perfil Júnior 1." The board, made of PVC, illustrates the interior of a prokaryotic cell and has 60 spaces. The material comprises 272 cards, divided equally between "clue cards," which describe ten characteristics of the secret profile (the organism to be discovered), and "visual clue cards," with images, diagrams, or microscopy photographs related to the answer. Four color-coded categories organize the content: characteristics, diseases and prophylaxis, ecology, and biotechnology and curiosities. The team requests the clues one by one until it formulates the answer, and progress is inversely proportional to the number of clues used, from ten to two spaces. Special spaces, such as "Todos jogam" and "Desenhista em ação," diversify the ways of answering. The game also

includes a rulebook and a glossary with the answers to all cards, intended to support the teacher.

In turn, the game "Qual é o bicho?" (Dias and Chacur, 2019) addresses vertebrate Zoology, covering the classes of fishes, amphibians, and reptiles, and is inspired by the game Cara a Cara. It uses two boards, cards illustrated with animals, and descriptive cards. Each team has a board with 14 animals and secretly selects a descriptive card. The opposing team asks yes-or-no questions and eliminates the animals that are incompatible with the characteristics indicated. The match ends when an animal is correctly identified, and the team that accumulates the most points over the matches wins. According to Dias and Chacur (2019), the game stimulates reasoning and question formulation. The students showed interest, asked for new matches, and formulated increasingly elaborate questions, in addition to reviewing Zoology content.

Completing the group, "Descobrimos os artrópodes" (Teles, 2020) has a 24-space board, each space associated with a species represented by a specimen preserved in resin. Participants, individually or in groups, identify the animals from clues related to their characteristics. Each space presents an initial clue, and two additional clues, on cards, may be requested. The value of the answer decreases with the number of clues used: three, two, and one point. Once the species is identified, the specimen is placed on the corresponding space. In this game, the teacher acts as a mediator throughout the process, checking the answers and recording the score.

3.3 Association and simulation games

The last three games identified in the search (a domino game, a card game, and a dice game) are distinguished by requiring students to establish relationships between concepts or to make decisions based on scientific rules of content previously covered in class.

The first of them, "Dominó Cnidários" (Silva and Carvalho, 2021), consists of 28 pieces and addresses, within the phylum Cnidaria, body organization, nutrition, reproduction, and aspects related to coral reefs. The class is organized into groups of six students, and each participant receives four pieces. The pieces are placed at the ends of the sequence by matching image and concept. As in conventional domino games, the match ends when one of the players runs out of pieces.

Following a different logic, "Oikos" (Santos and Bastos, 2025) is a card game, adapted from UNO, focused on Ecology and the relationships among living beings. The deck comprises 48 regular cards, in which each animal is associated with its ecosystem, distributed in four sets (Brazilian, African, North American, and Asian). There are also special cards that represent ecological situations and concepts, such as ecological imbalance, reintroduction, and environmental crime. Each participant receives seven cards and can only play a card that is related to the card on the table in terms of habitat, ecological niche, family, species, or ecosystem. The special cards, in turn, change the course of the match. They can make the next player draw cards, lose a turn, reverse the direction of play, or change the ecosystem in play. A participant who has no compatible card must draw cards from the deck until finding one that can be played. The winner of the round is the first to get rid of all the cards in hand. A scoring system based on the cards remaining with the other players may also be adopted.

Finally, "Sangue que salva" (Sousa et al., 2022) addresses the ABO system and the Rh factor through the simulation of transfusions. In pairs, participants receive a representation of a blood bag, with a sliding card, and five dice, each with a distinct function. Three standard dice simulate the tests with anti-A, anti-B, and anti-Rh sera and, together, determine the blood type tested. The fourth die indicates the direction of donation, that is, which of the types acts as donor and which as recipient. The octahedral die corresponds to the eight possible blood types and represents the other blood involved in the transfusion. In each round, participants roll the five dice, interpret the reactions to the sera, relate the identified type to the one indicated on the octahedral die, and check, according to the direction drawn and the compatibility rules, whether the transfusion is feasible. If it is feasible, the pair moves the card to the level corresponding to the volume donated. The activity ends when one of the pairs empties the bag.

3.4 Contributions and limitations of educational games for Science learning

The 13 studies analyzed show that the use of educational games contributes significantly to increasing students' engagement and active participation in Science teaching. This result can be understood from the characteristics of ludic resources themselves, which allow students to interact with content, make decisions, solve challenges, and establish relationships among previously presented knowledge (Ferreira et al., 2024).

In board games such as the "Jogo do DNA" and "Descobrimos os artrópodes," different learning mechanisms were combined, through clues and questions that fostered students' involvement with the content (Travessas et al., 2020; Teles, 2020). Similarly, the use of images in "Dominó Cnidários" (Silva and Carvalho, 2021) shows that different ludic structures and mechanisms can be adapted to the particularities of the content addressed. This diversity of arrangements makes the teaching and learning process more dynamic, because it allows the game format to be matched to the cognitive demands of each scientific topic. This dynamism is supported by Svorotova (2019), who associates games with faster and more complete memorization, owing to the dynamic, repetitive, and intensive use of associative memory.

The findings also relate to student agency, a central axis of ALMs. Cunha et al. (2024) emphasize that these approaches place the student at the center of the process, stimulating autonomy, participation, critical thinking, and reflection. In "Sangue que salva" and "Oikos," this role is evident: participants must retrieve scientific concepts on blood compatibility and ecological relationships to make decisions throughout the match (Sousa et al., 2022; Santos and Bastos, 2025). The need to interpret this information and apply it to the rules of the game brings scientific content closer to situations that demand analysis and problem solving. This favors the connection between theory and practice and the development of reasoning through its application in real-world contexts.

The collaborative dimension is another relevant axis of this active participation. In "Trilha dos Répteis" and "Qual é o bicho?" (Oliveira and Oliveira, 2021; Dias and Chacur, 2019), individual student involvement was observed, as well as collective discussions when answering the questions posed. Ferreira et al. (2024) point to this collaborative potential in board games, which provide opportunities for interaction, collaboration, and teamwork. Thus, the game can create situations in which students need to talk to one another to build answers together.

This dynamic also helps bring scientific content closer to students' reality. The games "Guardiões da Biodiversidade" and "Batalha Viral" addressed themes related to biodiversity, the environment, and health (Schultz et al., 2021; Rzy and Crisostimo, 2020). Contextualizing these themes brings school knowledge closer to everyday life and values problem-posing and the application of knowledge in real situations (Cunha et al., 2024). It

also tends to reconfigure the relationship among student, knowledge, and teacher, since the student participates more directly in learning situations (Conceição et al., 2020).

Greater student participation, however, does not dispense with the teacher's role. The use of games requires planning and mediation because, according to Cunha et al. (2024), in ALMs the teacher guides students' actions and builds the bridge between the lived experience and the knowledge to be constructed. The teacher is responsible for defining the objectives of the activity, selecting or designing the game according to the intended content and skills, monitoring its development, and intervening when necessary (Padilha and Arrigo, 2026).

This need for mediation appeared in "Explorando Biomas," in which students' difficulties with reading and interpretation required the teacher's intervention (Barbosa and Sun, 2025). In this case, the game made it possible not only to work on content related to biomes but also to identify obstacles that interfered with the activity. This shows the potential of the ludic resource as a tool for monitoring learning, provided that the teacher is attentive to the responses, strategies, and difficulties shown during the match (Padilha and Arrigo, 2026).

In this perspective, Dellafavera et al. (2024) argue for the need for formative and diagnostic assessment in proposals that involve ALMs. According to the authors, in the context of games, assessment can take place during the activity itself, by observing the answers, the strategies used, the capacity for argumentation, and the way students use the content to solve challenges. The game thus provides input for the teacher to identify learning gaps and plan later interventions.

Moreover, the involvement and motivation aroused by games do not, in themselves, constitute evidence of conceptual learning. Although playfulness can arouse interest and favor participation (Kishimoto, 2017), engagement in the activity must be distinguished from the effective appropriation of concepts. A student may take an active part in a match and still show difficulties in understanding. The game should therefore be combined with moments of discussion, systematization, and review of the content, so that the ludic experience becomes learning (Kishimoto, 2017).

Finally, it should be noted that the integration of educational games into Science teaching is supported by the guidelines of the Brazilian National Common Core Curriculum (Base Nacional Comum Curricular, BNCC). The document establishes that the teaching of

Natural Sciences should enable the analysis and understanding of phenomena, the formulation of questions, the search for answers, and the development of solutions grounded in scientific knowledge. Among the specific competencies of the area, it highlights the use of investigative procedures, the construction of arguments based on evidence, the solving of everyday problems, and participation in scientific discussions (Brazil, 2017). In this sense, games that involve decision-making, challenge solving, information interpretation, and argumentation can contribute to the development of these competencies, provided they are linked to learning objectives. When integrated into the curriculum, these resources tend to promote more meaningful and contextualized learning, in contrast to exclusively lecture-based practices (Branco et al., 2015; Cieslak et al., 2020).

4 FINAL CONSIDERATIONS

The games mapped in this review suggest that playfulness offers middle school Biology teaching a pathway to convert abstract content into lived experience. In the analyzed studies, the scientific concept is no longer presented as mere information to be delivered; it begins to function as an instrument for decision-making, responding, and arguing. The heightened interest, active engagement, and collaborative interaction reported by the authors are linked to this transformation. This is the central contribution of games: a repositioning of learners, who move from passive receivers to agents of their own learning trajectories. Such potential, however, relies on teacher mediation to bridge the playful experience and the systematization of concepts.

Therefore, when purposefully planned by teachers, educational games extend far beyond entertainment and emerge as an effective pedagogical strategy. By converting abstract Biology topics into concrete, interactive, and pleasurable experiences, they disrupt rote-based instruction, foster student agency, and resignify Science learning in middle school. It is learning by doing Biology.

These findings, however, should be interpreted in light of certain limitations. The corpus is limited, the search covered only two databases, and the included studies consist mainly of game development and implementation reports without designs to measure learning gains. Thus, this analysis remains bounded by the authors' perceptions and records. Future studies should adopt designs capable of assessing learning outcomes, such as pre-

and post-tests or comparison groups, and should also investigate digital and hybrid games, which were not present in the corpus analyzed.

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DATA AVAILABILITY STATEMENT

The entire dataset supporting the results of this study is published within the article itself.

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest related to this article.

STATEMENT ON THE USE OF AI

The artificial intelligence tool Claude (Anthropic, model Claude Sonnet 5.5) was used to support language revision and the standardization of bibliographic references.

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