Building knowledge: from the production of paradidactic material for environmental education in the Cerrado to the training of teachers

Construindo saberes: da produção do material paradidático para a educação ambiental no Cerrado até a formação de professores

Construcción de conocimiento: de la producción de material paradidáctico para la educación ambiental en el Cerrado a la formación docente

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ABSTRACT
The creation of supplementary educational materials for environmental education, such as the book “Trees of the Cerrado: Economic and Social Importance in Environmental Education” is essential to actively and contextually engage students. The development of this material involved adapting scientific knowledge into accessible language, as well as contextualizing it with the students’ reality to make learning more relevant. To maximize the implementation of environmental education in schools, teacher training was conducted, focused on the Cerrado biome. This aimed to empower educators to integrate environmental content in an
interdisciplinary manner, promoting awareness and preservation of the environment. The book was developed based on comprehensive research and a focus on the biodiversity of the Cerrado, emphasizing the socioeconomic value of local trees. Practical methodologies, such as educational games, were used to stimulate student interest and promote meaningful learning. The supplementary material and teacher training aim to prepare future generations to consciously deal with environmental challenges, promoting quality education and sustainability. The preliminary evaluation of the training showed positive results, highlighting the importance of initiatives like this to strengthen awareness and conservation of the Cerrado through the use of supplementary educational materials.

**Keywords:** Brazilian Savanna, supplementary educational material, interdisciplinarity, environmental education, awareness.

**RESUMEN**
La creación de materiales paradidácticos para la educación ambiental, como el libro "Árboles del Cerrado: Importancia económica y social en la educación ambiental", es fundamental para involucrar a los estudiantes de forma activa y contextualizada. La elaboración de este material implicó la adaptación del conocimiento científico en un lenguaje accesible, así como la contextualización con la realidad de los estudiantes para hacer más relevante el aprendizaje. Para maximizar la implementación de la educación ambiental en las escuelas, se llevó a cabo una capacitación de docentes de los últimos años de la educación básica, centrada en el bioma del Cerrado, que tuvo como objetivo permitir a los educadores integrar los contenidos ambientales de forma interdisciplinaria, promoviendo la conciencia y la preservación del medio ambiente. El libro fue desarrollado sobre la base de una investigación exhaustiva y un enfoque en la

**Palabras-chave:** Savana Brasileira, material paradidáctico, interdisciplinaridade, conscientização.
biodiversidad del Cerrado, enfatizando el valor socioeconómico de los árboles locales. Se utilizaron metodologías prácticas, como los juegos educativos, para estimular el interés de los estudiantes y promover el aprendizaje significativo. El material paradidáctico, el libro "Árboles del Cerrado: Importancia Económica y Social en la Educación Ambiental", los juegos de rompecabezas presentados en este artículo y la formación de profesores tienen como objetivo preparar a las futuras generaciones para enfrentar conscientemente los desafíos ambientales, promoviendo una educación de calidad y sostenible. La evaluación preliminar de la capacitación mostró resultados positivos, destacando la importancia de iniciativas como esta para fortalecer el conocimiento y la conservación del Cerrado a través del uso de materiales paradidácticos.

**Palabras clave:** Sabana brasileña, material paradidáctico, interdisciplinariedad, conciencia.

### 1 INTRODUCTION

The creation of paradidactic materials is an important way to improve teaching in the classroom, especially in transversal subjects such as environmental education (Menezes; Santos, 2001). Developing this type of material is a complex work that brings together knowledge from different areas and creative pedagogical methodologies (Bassachs et al., 2020). This initiative is illustrated in the book "Árvores do Cerrado: Importância Econômica e Social na Educação Ambiental", which offers a deep insight into the Cerrado, showing its rich biodiversity and its economic and social implications for environmental education (Weichert et al., 2023).

The goal was to create material that would not only inform, but also inspire and motivate students to become agents of change in their communities, resulting in positive and lasting behavioral change of students regarding individual and collective actions regarding environmental protection through education. To this end, active methods were introduced, providing interest and engagement.

Active learning methods offer pathways for students to be the main agents of their education. In this process, they absorb knowledge more meaningfully, guided by an experienced educator who plans teaching activities with clear intention (Medeiros et al., 2022).

When lessons are based on active learning, students tend to engage and be more interested in the content than with traditional ways of teaching (Demirci, 2017).

Teaching in a way that connects content with real life and integrates different areas of knowledge helps make learning more relevant and complete (Perin, 2011). In this sense, the
methodology applied in the elaboration of the paradidactic material mentioned above provides the ideal connection in teaching and learning.

Brazil, a country graced with exuberant biodiversity, has its natural richness reflected in the diversity of its six unique biomes: the vast Amazon, the robust Cerrado (Brazilian Savanna), the lush Atlantic Forest, the resilient Caatinga, the open grasslands of the Pampa and the wetlands of the Pantanal (IBGE, [s.d.]) (Figure 1). Each biome is a world apart, home to a unique, rich and colorful plant and animal life. While some species travel freely between biomes, others are treasures unique to their regions, not found anywhere else (Weichert et al., 2024b).

Figure 1. Representation of the map of Brazil with its six biomes.

The majestic Amazon stretches its green mantle, covering almost half of Brazil with its lush forest and winding rivers (IBGE, [s.d.]). This place is a true mosaic of life, where a multitude of plant and animal species coexist, sheltered by the largest and most lush rainforest on the planet (WWF BRASIL - AMAZÔNIA, [s.d.]).

The Cerrado, Brazil's second largest biome, is a biodiversity sanctuary. With an impressive variety of unique life, it is home to approximately 30% of Brazil's species and nearly 5% of the world's natural wonders (WWF BRASIL - CERRADO, [s.d.]).

The Atlantic Forest, which extends as the third largest biome in Brazil, is a natural forest under threat, being the second most vulnerable forest on the globe (INSTITUTO BRASILEIRO DE FLORESTAS, [s.d.]).
The Caatinga, a biome with semi-arid features, stands out for its resilient vegetation, which bravely adapts to aridity, and for being the mantle that surrounds much of the heart of the Brazilian Northeast (Souza et al., 2020).

The Pampa, with its vast plains of low vegetation, is a countryside setting that is home to a rich diversity of animals, painting southern Brazil with its natural colors (IBGE, [s.d.]).

The Pantanal is an aquatic sanctuary where a myriad of plants and animals flourish, famous for being the largest floodplain in the world, a spectacle of life and water (Aparecida Sonoda et al., 2021).

Elementary school students should be made aware and educated about the importance of preserving each biome, knowing its species, nutritional and medical uses, and its contribution to the sustainability of local communities (Weichert et al., 2024a).

The paradidactic material presented in this article shows in a simple way, with accessible language, knowledge about the importance of raising awareness and preserving the Cerrado biome, its rich diversity and all the grandeur of Brazil.

This paradidactic material not only provides information, but also inspires young students to recognize and protect one of Brazil's richest and most vulnerable biomes. The book helps to form citizens who are more aware and participative in the defense of the environment, using an interdisciplinary and participatory approach, connecting environmental education to curricular components.

Environmental preservation will only be efficient when the population knows the diversity of Brazilian biomes, so we will have conscious citizens, to make better use of natural resources with sustainability and maintaining national identity.

2 DEVELOPMENT OF PARADIDACTIC MATERIAL

The support material was carefully created following the principles of socio-cultural teaching, an educational philosophy rooted in the transformative ideas of Paulo Freire.

The creation of paradidactic books arose from discussions about the importance of Brazilian authors writing for children and adolescents (Laguna, 2001). The aim was to cultivate in them a love of reading, an appreciation of literature, and the joy of immersing themselves in books.
Paradidactic materials, both for teachers and students, are true treasures that enrich the path of knowledge. They introduce essential concepts and content, helping the student navigate the complexities of social, cultural, and economic aspects, and thus enabling them to engage meaningfully in society (Souza, 2018).

The National Curriculum Parameters (NCPs) recognize paradidactic materials as gems that often address cross-cutting themes – those that go beyond the basic content of textbooks – and add an extra layer of richness to lessons and classes meticulously planned by the teacher (BRASIL, 1998; Serra; Araújo, 2021).

In addition, paradidactic materials have the power to intertwine different areas of knowledge, bringing scientific knowledge closer to daily reality. In this way, they are valuable tools that help students to exercise their citizenship in a complete and conscious way, especially when the central theme is environmental education.

A crucial point in the development of the material was to transform scientific knowledge into an accessible language for elementary school students. This required careful adaptation of the content, using didactic resources such as illustrations, infographics, and activities that facilitate understanding.

The contextualization of the educational content with the reality of the students was also essential. The creation of this material goes beyond the mere transmission of information, seeking to engage students in active and contextualized learning (Cordova; Lepper, 1996). This meant linking theoretical knowledge to practical and local examples, showing students how the conservation of the Cerrado can positively impact their lives and those of their families (Spera et al., 2016). This approach helps to make learning more relevant and meaningful by encouraging the practical application of acquired knowledge (Polman; Hornstra; Volman, 2021).

The review and validation of the material involved collaboration between educators and other experts, ensuring that the content was scientifically accurate, pedagogically appropriate, and culturally relevant (Anderson et al., 2022; Marosi; Avraamidou; Galani, 2021; Rahimi; Oh, 2024). The creation of paradidactic material such as this is a collaborative effort that aims to promote environmental education in a comprehensive way, preparing future generations to face environmental challenges in a conscious and informed way.
METHODOLOGY FOR THE DEVELOPMENT OF PARADIDACTIC MATERIAL

Paradidactic materials are those books and resources that, even if not strictly didactic, are used for this purpose. They are valued for incorporating more fun and creative elements than traditional teaching materials, which can make them effective tools for teaching. They earned their name because they are used in conjunction with conventional materials, enriching the learning process without replacing textbooks (Menezes; Santos, 2001).

Historically, it was Ática Publisher that inaugurated the first collection of wide-ranging para-didactic books in Brazil. These materials were seen as valuable resources to complement, enrich and make more accessible the presentation of content that was often transmitted in a rather dry way in textbooks (Munakata, 1997).

Paradidactic materials have gained a more prominent role in schools, especially after the end of the 1990s. This happened because of the Law of Guidelines and Bases of Education), which introduced the NCPs. These parameters encouraged the discussion of cross-cutting themes that are essential for citizenship education. As a result, there has been a growth in the creation of books that enter the classroom to enrich conversations on vital subjects such as Ethics, Cultural Diversity, Work, Consumption, Health, and Sexuality (BRASIL, 1998; LDB, 2017).

The development of the book begins with a thorough research on the subject, requiring a comprehensive review of the literature on the flora and fauna of the Cerrado. To approach the Cerrado, it was essential to collect scientific data on the local flora, highlighting the tree species that are important, both ecologically and economically, such as, for example, the Araticunzeiro (*Annona crassiflora*) (Ramos et al., 2022), the cagaiteira (*Eugenia dysenterica*) (Rodrigues; Costa, 2017; Costa et al., 2017), and the pequizeiro (*Caryocar brasiliense*) (Garcia et al., 2024), because its fruits are significant for the local economy and food.

The book was divided into subtitles related to the Cerrado and its fruit trees. The biodiversity and characteristics of the biome are highlighted. Fruits with great nutritional potential from the Cerrado; trees with great socioeconomic value, which were addressed succinctly and clearly to facilitate readers' understanding.

Information was gathered about the benefits that these and other species bring to the community, including medicinal uses, such as the Aroeira, whose scientific name is *Myracrodruon urundeuva*, which has anti-inflammatory properties (Figueiredo et al., 2022), and...
the yellow ipê, *Handroanthus serratifolius*, which has studies that have shown potential in fighting parasites that live inside cells and in stopping the growth of cancer cells (Mazzinghy *et al*., 2024), in order to rescue the ingrained knowledge that local communities with knowledge possess, but which has been lost with the pharmaceutical facilities found today. The Pequi, which in addition to medicinal potential, has great nutritional benefits (Garcia *et al*., 2024, Melo *et al*., 2024), and industrial benefits, in addition to emphasizing the crucial role of trees in environmental preservation and in the fight against climate change.

Objective and clear language was used to ensure that the content was relevant and accessible to the target audience (Kuehne *et al*., 2014; Parker, 2023). To make the material more attractive and didactic, it was essential to use high-quality illustrations, designed especially for this material (Figure 2).

![Illustrations presented in the paradidactic material.](source)

The book highlights ecological processes, hydrography, and soil types; these sub-themes are in line with the Geography curricular component, providing interdisciplinarity in the use of the material produced, especially in the proposed activities directed to this content.

The book was developed and published with open access, via DOI: The book was developed and published with open access, by DOI: [https://doi.org/10.37885/978-65-5360-220-5](https://doi.org/10.37885/978-65-5360-220-5), providing free access to all.
TEACHER TRAINING

For learning to be truly meaningful, it is essential that teachers are innovative, prepared and aware of the importance of reflecting, debating and filtering information from the most diverse sources (Kenski, 2015).

The traditional classroom dynamics, where the teacher is the speaker and the student is the passive listener, needs to undergo transformations. It is necessary to rethink how to teach and how students learn, considering the technological and social changes that surround us (Nascimento; Mesquita; Viana, 2021).

From the teacher’s perspective, it is essential to be prepared for an educational process in which knowledge is built in an active and collaborative way. In this context, it plays an active role in all pedagogical planning, contributing to the creation of an enriching and participatory learning environment (LDB, 2017).

With the elaboration of the paradidactic material involving environmental education and the Cerrado, the need arose to offer training to teachers of fundamental education in the public schools of São Joaquim de Bicas, Minas Gerais, Brazil, focused on the theme "Trees of the Cerrado". In this way, six teachers who teach diversified content to sixth-grade students were invited. Teachers from the following curricular components participated: Geography, History, Portuguese Language and Mathematics, one from each area, and two Science teachers.

Environmental education is fundamental for teachers (Oliveira, 2024). This formation was concentrated in the Cerrado, the second largest biome in Brazil, which has great biodiversity and ecological importance (Weichert et al., 2023a). The idea was to train educators to use interdisciplinary methods to integrate environmental content, while increasing awareness and preservation of the Cerrado among students. Therefore, the objective of the proposal was to train educators to teach about the importance and richness of the Cerrado biome, highlighting its characteristic flora in a holistic and integrated way.

Located in a transition area between Cerrado and Atlantic Forest (“SÃO JOAQUIM DE BICAS - MG - INFOSANBAS”, [S.D.]), the city of São Joaquim de Bicas provided an ideal context for this training, which combined theoretical and practical approaches, aiming to involve teachers in a dynamic and interactive way.
During the training, teachers learned about the biodiversity of Cerrado, the importance of native trees in the ecosystem, and the challenges of their sustainable conservation (Weichert et al., 2023b). The methodologies included lectures with conversation circles, practical workshops, educational games and classroom activities, allowing educators to experience the Cerrado and its arboreal richness (De Oliveira Souza et al., 2018; JESUS et al., 2022).

These methods were well received by the participants who showed great interest and enthusiasm in applying the new knowledge in educational practice, promoting environmental awareness among students.

5 TEACHER TRAINING METHODOLOGY

The training methodology was based on a participatory and practical approach, and involved teachers in activities that can be repeated in the classroom (DIAS; RIBEIRO, 2020; TULLIO et al., 2005). First, the training was structured in two modules, one theoretical and the other practical, lasting about 50 minutes each, ensuring a deep understanding of the concepts and their practical application.

5.1 THEORETICAL MODULE

In the theoretical module, teachers learn about the geographical, biological and climatic characteristics of the Cerrado, biodiversity, endemic species, associated ecosystems, and the environmental problems faced, such as deforestation and soil degradation. All of these topics are covered through targeted readings and chat.

5.2 PRACTICAL MODULE

The practical module includes workshops and one of the main activities is the board game about the Cerrado. This allows teachers to recap the topics discussed and also review the reading of the paradidactic material.

Using fun teaching tools, such as educational games, can make learning about the environment more engaging. These tools help students think more deeply about environmental
issues, pay more attention, interact more with others, and have fun learning, which can lead to better understanding and retention of information (Abílio, 2008).

When students participate in playful games, they have the opportunity to learn concepts in an interactive way, together with other people. This approach contributes to cognitive development, providing a more engaging and meaningful experience. Theorists Vygotsky, Leontiev, and Elkonin consider playful activities as fundamental for students' growth and learning (Rocha, 2009).

Play is a fantastic way for children to make friends and build things. It's not just fun; helps them grow and teaches them how to work together (Piaget, 1978).

The board game "Cerrado em Foco" was redesigned with questions directed to the target audience: elementary school students from the municipal education network in São Joaquim de Bicas. The original game, developed by the students of the Federal University of São João del-Rei – Campus Sete Lagoas (Sete Lagoas, Minas Gerais, Brazil), specifically members of the Teaching, Research and Extension Group in Chemistry and Pharmacognosy (GEPEQF), was designed with a focus on an audience of people living in a region exclusively in the Cerrado biome. As the target audience for this work were students living in a biome region of transition from Cerrado to Atlantic Forest, adaptations and even reformulations were necessary in the questions contained in the cards on the board (Figure 4, original cards and Figure 5, adapted cards).
Figure 3. Representation of the original board game "Cerrado em Foco" (in Portuguese).


Figure 4. Representation of cards original from the game "Cerrado em Foco" (in Portuguese).

For the adaptation of the game's questions, it was necessary to pay attention to the regional issues that permeate the daily life of the target audience. Thus, most of the questions underwent a restructuring so that there was success in its application. The questions were developed with a focus on the subjects presented in the book “Árvores do Cerrado: Importância Econômica e Social na Educação Ambiental” and in the themes addressed in the intervention classes.

Integrating puzzles into environmental education is an effective way to engage students with issues related to the environment. The puzzles offer a playful and interactive approach, allowing students to explore, in a practical way, concepts such as biodiversity, natural cycles, conservation and sustainability, ecologically correct actions, among others.

Through the use of Bing Designer Artificial Intelligence, authorial images were elaborated and also with the use of illustrations from public domain images such as VectorStock, for the making of some puzzles. From there, they were introduced to the teachers, providing a playful learning option. These games allow the identification of animals and show ecological actions in an awareness-raising way and allow discussion about the importance of environmental conservation. For each proposed puzzle, it is necessary to put the references and the reason for the conception of the puzzle, how it will be linked to environmental education.
By assembling puzzles, students develop cognitive skills, such as spatial reasoning, problem-solving, and patience. In addition, the group activity during the assembly promotes teamwork and communication among students (BRASIL, 2013). This strategy makes learning about the environment fun and educational, encouraging students to connect deeply with the material and with each other, facilitating the internalization of the acquired knowledge.

The first puzzle presented was with the illustration of a representative of the fauna and who is an icon of the Cerrado, the lobo-guará (*Chrysocyon brachyurus*) (Figure 6).

![Figure 6. Puzzle illustration: lobo-guará.](source: Authors (2024).)

The lobo-guará, majestic and solitary, it travels through the fields of the Brazilian Cerrado, leaving its footprints in the red earth. With its reddish fur and long legs adapted to savannas, it is the largest canid in South and Central America. In recent decades, researchers have been unraveling the secrets of this enigmatic animal, revealing its presence even in the Amazon and challenging the known boundaries of its distribution (Sugimoto, 2020). In addition, genetic analyses point to an intriguing evolutionary history, marked by events of population expansion and retraction (Prates Júnior, 2008). Protecting the lobo-guará is preserving not only a species, but also the ecological richness of our vast continent (Silva-Diogo *et al.*, 2020).

This animal is not considered a true wolf, but rather a distinct canid. The lobo-guará plays a crucial role in the ecology of the ecosystems in which it lives. Their diet is varied, including fruits, small vertebrates and insects. However, it is in seed dispersion that it stands out. When consuming fruits, the seeds pass through your digestive system and are excreted intact in the
This contributes to the regeneration of natural areas, as these seeds germinate and become new plants (Ferreira, 2023; Motta Junior, 2000).

In addition to its function as a seed disperser, the lobo-guará helps control rodent populations, such as rats and Brazilian guinea pig. This regulatory predation is essential to maintain balance in ecosystems, avoiding overpopulations of these small mammals.

Another elaborate puzzle proposal was related to flora, presenting a typical tree of the Cerrado, the yellow ipê (Figure 7). The ipês belong to the genera *Tabebuia* and *Handroanthus* (Mazzinghy *et al*., 2024). This tree is one of Brazil's natural gems, which looks like it was hand-painted by a talented artist. The yellow ipê, for example, with its golden flowers, like small suns, blooms in profusion, illuminating the scenery with unparalleled beauty. When it blooms, it's as if nature itself is celebrating. Its delicate petals dance in the wind, creating a spectacle that transcends the visual and touches the soul.

In addition to its stunning aesthetics, the yellow ipê is a symbol of Brazil (Mazzinghy *et al*., 2024). It represents the strength, resilience and diversity of the Brazilian flora. Rooted in the Cerrado, one of the richest and most threatened biomes in the world (Weichert *et al*., 2024b), the yellow ipê, as well as other species from the Cerrado, faces challenges such as former agricultural expansion, and climate change (Klink; Machado, 2005; Lorenzi, 1992; Ribeiro; Walter, 2008). However, it persists, resisting with firm branches and deep roots. Just like the Brazilian people, the yellow ipê is resilient and vibrant.
These activities were developed with the aim of arousing the curiosity and involvement of students, in order to promote active and meaningful learning, contributing to the internalization of the knowledge acquired.

6 TOOLS AND RESOURCES

In Brazil, the National Common Curriculum Base (BNCC) considers the environment as a crosscutting theme. However, many teachers still do not adequately explore environmental issues in their classes. To assist these professionals in the implementation of the contents and enhance the use of the paradidactic material, a set of interdisciplinary activities was developed with the objective of maximizing its use in various disciplines, such as Science, Geography, History, Portuguese Language, and Mathematics (De Oliveira Souza et al., 2018; Massuga et al., 2020).

The interdisciplinary activities presented are included in the paradidactic material. These examples show that environmental education can be transversalized anywhere, especially in a school environment (Massuga et al., 2020).

Science teaching in elementary school plays a crucial role in the formation of citizens who are aware of and engaged with environmental issues. When approached in an integrated way with environmental education, it becomes even more relevant. In view of this, questions were elaborated relating the discipline of Science with environmental education in the Cerrado (Figure 8).
The Geography classroom is a space conducive to exploring not only the physical and human aspects of our planet, but also to understand the interactions between society and the environment (ESTADUAL et al., 2021). In view of this fact, it was possible to develop Geography activities intrinsically related to environmental education in the Cerrado (Figure 9a). This approach allows students to understand geographical concepts and become active agents in the preservation of the environment.
The integration of the teaching of History with environmental education offers a valuable opportunity for the formation of citizens who are aware of and engaged with environmental issues. When these two fields intertwine, students not only learn about historical events but also understand how human actions influence the environment (Rodrigues; Machado, 2023). Environmental History stimulates discussions about humanity's relationship to nature by examining past events that have shaped the current environment. Incorporating this perspective into the History discipline, teachers can address topics such as natural disasters, the use of natural resources, the impacts of industrialization, and climate change. This approach broadens students' understanding of the past, while connecting them with the environmental challenges of the present (Pino, 2024). In this way, questions were elaborated that would bring to light relevant information regarding the subject of history in the Brazilian Cerrado (Figure 9b).

Rodrigues and Barbosa (2021) explored digital games with the aim of improving the teaching and learning of spelling writing in Portuguese relating to environmental education. These activities focused on spelling "errors" related to context and grammatical morphology. The results were promising, demonstrating a significant reduction in spelling mistakes among the research participants (Rodrigues, 2024).
Following this same line of reasoning of linking the Portuguese language with environmental education, activities were developed for the paradidactic material. The questions related both spelling "errors" related to context and grammatical morphology, as well as text interpretation (Figure 10).

![Figure 10. Portuguese questions](source: Weichert et al. (2023), p. 72)

By addressing mathematical problems involving environmental issues or related to environmental projects, as was the proposal developed, where the study was directed to environmental education in the Cerrado, it is possible to introduce fruits from the Cerrado in mathematical calculations (Figure 8). It is essential that educators seek to integrate mathematical concepts with environmental problems, promoting a broader and more applied understanding of the discipline (Ferreira Leite et al., 2009; Jesus; Conceição; Oliveira, 2020).
7 CONCLUSION

Teacher training with a focus on environmental education in the Cerrado has proven to be an effective strategy to raise awareness of the value of this biome. The idea is to incorporate environmental education into the school curriculum in a meaningful way, providing educators with theoretical and practical knowledge, as well as teaching tools and resources.

The involvement of the students shows the benefits of this class; They develop a critical sense and an active attitude to protect the environment. The training also helps create a network of educators committed to sustainability who have a positive impact on their communities.

In summary, in order to face contemporary environmental challenges, it is essential to invest in continuing education for teachers. It is possible to ensure that future generations are prepared to care for and preserve the Cerrado, ensuring its sustainability for Brazil and the world, promoting high-quality environmental education.

The use of paradidactic material should increase students' awareness of the importance of preserving the Cerrado and promoting sustainable practices. In addition, students are expected to develop a sense of responsibility for the environment and understand the interdependence between the environment and human beings. In addition, the book aims to inspire practical conservation actions at the school and community level.
The paradidactic material is more than a simple learning resource; it serves as a source of inspiration for students, encouraging them to value and advocate for one of Brazil's richest and most endangered ecosystems. By promoting the formation of engaged citizens who are aware of the importance of environmental preservation, the book adopts a methodology that integrates several disciplines and encourages active participation.

This material stands out as an innovative and effective model of environmental education that can be used in other places and contexts. When combined with interactive educational methodologies, the connection between scientific knowledge and traditional knowledge improves the impact of learning and promotes a more sustainable future.

The initial evaluation of teacher training in São Joaquim de Bicas showed promising results, indicating a positive reception to the training. The teachers showed enthusiasm in incorporating what they learned and actively sought ways to promote awareness about the Cerrado at school through environmental education. They highlighted the importance of an interdisciplinary approach to facilitate learning and deepen knowledge about Cerrado trees, contributing to a more contextualized and sensitive education to environmental issues, suggesting that such efforts can strengthen the link between education, conservation and appreciation of local natural heritage. The continuity and expansion of these initiatives are essential to foster awareness and commitment to the conservation of the Cerrado and its unique trees.

However, this evaluation is provisional and a more comprehensive and long-term analysis will be needed to measure the real impact of the training on educational practice. Future evaluations will allow us to measure more accurately the scope of the initiatives implemented and their contribution to environmental education and sustainability in local public schools.

In conclusion, it is known to say that it is not enough to develop just a paradidactic material, it is necessary to have training for teachers to have more positive and lasting results.

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Supplementary material

Figure S1. Cover of the paradidactic material: Árvores do Cerrado: Importância Econômica e Social na Educação Ambiental

Source: Authors (2024).

Figure S2. QRCode of access to paradidactic material.

Source: Authors (2024).
Regras do jogo “Cerrado em Foco”.

Agora é a sua hora de dar um show de conhecimento e arrasar nessa brincadeira divertida que o jogo Cerrado em Foco vem trazendo pra você. Vamos lá!

Vamos dividir a turma em seis equipes. (Que tal nomear a sua equipe, escolham um nome que represente algo característico do Cerrado), cada equipe eleger um representante para mariscar as peças do jogo e responder às perguntas.

O jogo possui 70 casas do ponto de partida até a linha de chegada. É vencedora a equipe que chegar a casa de chegada primeiro. Por recurso de sorte, deve ser estabelecida a ordem do lançamento do dado e a peça referente a cada equipe.

A equipe avançará a quantidade de casas que ficar voltada para cima no dado, porém, terá direito de jogar o dado a equipe que responder corretamente a resposta de cartinha. Há no jogo 20 cartas com perguntas sobre fauna, flora, cultura e curiosidades do Cerrado e claro, sobre Educação Ambiental.

Todas as Questões são baseadas nas intervenções realizadas em sala de aula e principalmente no livro “Avóres do Cerrado: Importância Econômica e Social na Educação Ambiental”.

Durante o percurso do jogo os jogadores podem encontrar obstáculos, como:

Desafio: Fique uma rodada sem jogar. Jogue o dado novamente e retorne a quantidade de casas referente. Perdeu a vez e a sorteada opção de Jogar o dado novamente.

Desafio: ao cair no desafio o jogador deverá responder a duas cartinhas. Se responder corretamente, avance 3 casas; se responder errado, fique uma rodada sem jogar. (Cherada. No último desafio, o que vai compensar, responder cartinha, ou na mesma casinha decidir ficar?).

E se a rodada sem jogar: Essa casinha te limita a ficar uma rodada sem lançar o dado, ou seja, você passará a vez para o próximo participante.

Jogue o dado novamente e retorne a quantidade de casas referente. Ao avançar no jogo e cair nesse obstáculo o jogador deve lançar novamente o dado e retornar as casinhas sorteadas no dado.

Perdeu a vez: significa uma rodada sem jogar.

Jogar o dado novamente. Esta opção te dá o direito de jogar o dado novamente. Avançar as casas sem ter que responder cartinhas.

Boa Sorte Galerinha, vamos juntos aprender brincando!

Source: Authors, adapted from GEPEQF (2024).
Figure S4. Puzzle elaborated and presented to teachers during training

Source: Authors (2024).

Figure S5. Puzzle elaborated and presented to teachers during training

Source: Authors (2024).
Figure S6. Puzzle elaborated and presented to teachers during training

Source: Authors (2024).

Figure S7. Records of teacher training.

Source: Authors (2023).
Figure S8. Records of teacher training.

Source: Authors (2023).