



CONSERVATION TREE: A GAME FOR TEACHING SCIENCE, BOTANY, AND ENVIRONMENTAL EDUCATION

BIBLIOMETRIC REVIEW

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ABSTRACT

In recent decades, the teaching of Biology and Natural Sciences has been primarily focused on preparing students for college entrance exams (Silva, 2019), reducing education to the memorization of concepts, rules, and processes and limiting nature to repetitive events (Costa; Mota; Brito, 2021). To fully comprehend scientific knowledge, it's necessary to consider everything that surrounds the organisms discussed in these courses (Monerat & Rocha, 2018). Botany education was, for an extended period, disconnected from the natural environment (Pereira-Ribeiro *et al.*, 2018). Publications in the field predominantly emphasized foreign flora and landscapes over domestic ones, leading to a decline in interest in botany (Mello, 1996) and, consequently, neglecting the native landscape as part of students' daily life. Alternative teaching tools are crucial for understanding the subjects taught in the classroom and for retaining the terminology and concepts presented in theoretical classes across various disciplines (Perini & Rossini, 2018). The participation of students in group games aims to stimulate children and adolescents to develop logical reasoning and promote greater social integration among students (Paiva; Fonseca; Colares, 2022). In this context, this university extension project's primary objective is to develop and test methodological strategies as alternative tools for teaching Natural Sciences, Botany, and Environmental Education. The foundation of these strategies is botanical educational games rooted in regional flora, which



were tested in 6th-grade classrooms at the State School Maria Almeida do Nascimento in Coari/AM. The methodology includes meetings with student extensionists to outline evaluation measures, the application of games, and the dissemination of the results. These results have been made available as an alternative methodological tool for the school's teachers. As a result, it was observed that the game effectively facilitated the introduction and consolidation of botanical content, particularly in plant morphophysiology and environmental conservation, among community learners, who are 6th-grade students for whom the game is intended.

Keywords: University extension project, Development of educational games, Teaching Natural Sciences, Botany, and Environmental Education.

1. INTRODUCTION

According to Article 207 of the Federal Constitution, universities must adhere to the principle of the inseparability of teaching, research, and extension (Brasil, 1998), making this tripod a guiding precept governing the operation of Brazilian universities and defining their role in society (Lottermann *et al.*, 2019).

University extension is an academic activity that involves the transfer of knowledge, skills, and resources from the university to society at large, beyond the boundaries of the academic campus (Lamarca *et al.*, 2018). The main goal of this activity is to promote interaction between the university and the community, contributing to social, cultural, economic, and scientific development (Malosso; Alves; Santos, 2023).

Extension activities can include service projects such as consulting, healthcare services, legal guidance, training courses, workshops, cultural events, social responsibility initiatives, and other forms of community engagement (UFAM/PROEXTI, 2016).

According to Cruz *et al.* (2011), extension is a way to put into practice the knowledge produced at the university for the benefit of society, promoting inclusion, development, and knowledge dissemination.



With this latter goal in mind, we carried out this extension project. The general objective of this extension project was to stimulate the understanding and retention of natural science, botany, and environmental education content, particularly related to the conservation and use of genetic resources and plant morphophysiology through playful activities. The specific objectives were to develop an educational game to facilitate the retention of topics in Natural Sciences, Botany, and Environmental Education; encourage students to reconnect with natural vegetation; research and discuss methodological strategies for creating games; integrate the Institute of Health and Biotechnology of Coari with the Coari community; and encourage undergraduate students to develop methodological strategies and alternative tools for use in the classroom, aiming to facilitate learning and reinforce it for 6th-grade students at the State School Maria Almeida do Nascimento, located in the municipality of Coari, Amazonas. Environmental education, including botany, is one of the transversal themes of the National Common Curriculum Base (BNCC).

2. METHODOLOGY

This extension project consisted of seven distinct stages.

In the first stage, the student extensionists prepared the Informed Consent Form and Image Release Authorization (Annex 1) below, following the guidelines established by the Research Ethics Committee of the Federal University of Amazonas (CEP/UFAM). They submitted the form to the parents, requesting their signature to authorize the participation of their minor child in this educational activity, as well as the use of the child's image.



Annex 1: Informed Consent Form and Image Release Authorization:



Ministério da Educação
Universidade Federal do Amazonas
Pró-Reitoria de Extensão e Interiorização

Programa Atividade Curricular de Extensão – PACE (Capital e Interior) – 2023/1

TERMO DE CONSENTIMENTO LIVRE ESCLARECIDO E DE AUTORIZAÇÃO DE USO DE IMAGEM

Eu, _____, maior de idade, portador do CPF Nº _____ autorizo o uso da imagem de minha criança, _____ menor de idade, para fins de comprovação e divulgação dos Projetos de extensão PACE intitulados “A árvore da Conservação: um jogo didático para o ensino de botânica”, do Instituto de Saúde e Biotecnologia de Coari da Universidade Federal do Amazonas, e coordenado pela Profa. Dra. Milena Gaion Malosso, que pode ser contatada pelo telefone (xx)xxxxx-xxxx para o esclarecimento de qualquer tipo de dúvida. Tenho ciência de que minha criança será convidada a brincar com um jogo que versa sobre temas de ciências, botânica e de educação ambiental, e que esta corre o risco de cair no chão ou colidir-se com os colegas de classe durante esta atividade lúdica e autorizo-a a exercer esta atividade. Também estou ciente de que a criança pode parar de brincar no momento em que desejar. Aproveito a oportunidade para autorizar o uso da imagem de minha criança em qualquer tipo de meio de divulgação.

Assinatura

Source: Authors, 2023.

On the previously scheduled day, the student extensionists collected the properly filled and signed consent and image use authorization forms from the school's administration.

In the second stage, meetings were held with the student extensionists to inform them about the content of this extension action and to let them know that they should develop an educational game that would teach the contents of natural sciences, botany, and education in a playful manner to the 6th-grade students of Elementary School, as directed by the National Curriculum Guidelines (DNCC).



The student extensionists were instructed to conduct bibliographic research on the subjects of Natural Sciences, Botany, and Environmental Education in the "Science" books for the 6th grade of Elementary School, as recommended by the Ministry of Education, and they chose to work with the contents of the Natural Sciences book by Leite and Canto (2018), which was used at Maria Almeida do Nascimento State School. In this stage, the student extensionists read the entire book, aiming to connect the topics of botany and environmental education with the other topics of the book, such as zoology and ecology, among others. After reading, they drafted the questions used in the game and then created the PowerPoint slides, which were used as the game, as demonstrated by Schettino and Mendes (2021).

According to Ribeiro and Amorim (2022), the use of educational games aids in cognitive learning and the retention of theoretical content, which is why they are recommended as a teaching tool for elementary school students.

In the following meeting, the student extensionists proposed the game "The Tree of Conservation" as an alternative strategic tool for teaching these contents.

The subjects of natural sciences, botany, and environmental education were addressed in the form of questions, which covered the constituent parts of plants and their functions, photosynthesis, plant classification, the importance of plants for living beings, the use of plants by industries, food chains and webs, causes of environmental impacts and how to reduce or prevent them, the importance of environmental conservation, and the awareness that humans are part of the environment and by destroying it, they destroy themselves.

The questions were presented on slides, as seen in Figure 1:



Figure 1: A. Game opening slide; B. Presentation of one of the game questions



Source: Collection of the Extension Program for Conservation and Use of Plant Genetic Resources of Economic Interest at UFAM, 2023.

In the third stage of this extension action, a thorough analysis of the contents included in the game was conducted by the coordinators of this activity.

During these meetings, the game was also set up, consisting of a styrofoam tree painted with gouache that was attached to the chalkboard with masking tape and divided in half by an imaginary line. On each side of this line, 25 leaves made of green EVA with black marker-drawn veins were pinned with thumbtacks. A small bell was used, placed on a chair near the chalkboard, as well as a laptop connected to a data projector that displayed questions about various botanical topics on the board. The elementary school community students were separated into two rows, standing just in front of the chair with the bell, as shown in Figure 2.



Figure 2: Arrangement of teaching materials and elementary school community students in the classroom:



Source: Collection of the Extension Program for the Conservation and Use of Economically Valuable Plant Genetic Resources at UFAM, 2023.

In this stage, the game's operation and rules were also determined.



First, it is essential to note that each side of the imaginary line belonged to one of the two teams of community students divided into two lines.

The game worked as follows: an academic extensionist projected a question on the board, counted to 3, and said, "go." Then, the community students who were in the first position of the line had to run to the bell and ring it, as shown in Figure 3.

Figure 3: Community student running to the bell placed on the chair to answer the game question



Source: Collection of the Program for the Extension of Conservation and Use of Economically Important Plant Genetic Resources at UFAM, 2023.



The community student who reached the bell first had to answer the question. If they answered correctly, a leaf was removed from the tree on the opposing team's side. If they answered incorrectly, a leaf was removed from their side of the tree. The team that deforested their side of the tree first lost.

In the third stage, due to the great success of the game among the teachers who witnessed its application in their classrooms, at their request, meetings were held with teachers from various disciplines of Elementary School. The purpose was to clarify them about the criteria used in game application and train them to use this new tool in activities with their students. They expressed a keen interest in applying the theme content from various areas of knowledge to their students using this new teaching tool.

In the fourth stage, the academic extensionists, with the assistance of the coordinators of this extension activity, evaluated the results obtained from the game's application. The purpose was to identify the most relevant contents for the community and make the necessary modifications and adaptations to the game for better didactic-pedagogical utilization for teaching the subjects. This evaluation was carried out through a discussion round with elementary school students and teachers, seeking to understand what the community (students and educators) thought of participating in this extension activity, what they found most interesting, whether they learned any new content about the topics addressed through the game, and if there were any criticisms or suggestions for improvement.

In the fifth stage, the game was adapted based on the suggestions from the community, as shown in Figure 4. Furthermore, it was prepared for permanent production.



Figure 4: Elementary school students in the 6th grade recording their feedback and suggestions for the improvement of this extension activity



Source: Collection of the Extension Program for the Conservation and Use of Economically Important Plant Genetic Resources at UFAM, 2023.



In the sixth stage, the reports of the extension academic students were collected, as can be seen in Figure 5, and the final report of this extension activity was prepared and submitted to the Pro-Rectorate of Extension at the Federal University of Amazonas. In this stage, this article was also prepared.

Figure 5: Extension academic students sharing their experiences participating in this extension activity



Source: Collection of the Extension Program for Conservation and Use of Economically Important Plant Genetic Resources at UFAM, 2023.

3. RESULTS

University extension actions are of utmost importance in assisting the teaching of content in primary education, especially in the field of botany, for various reasons, as explained below:



1. **Closer University-Community Relations:** Extension actions enable the university to get closer to the primary education community (Silva, 2020), creating a bridge between academic knowledge and local needs (Fujita & Barreviera, 2014).
2. **Knowledge Exchange:** University students can share their specialized knowledge with primary education students and teachers, enriching education with up-to-date information and innovative approaches (Henriques & Silveira, 2021).
3. **Educational Resources:** Through extension actions, educational materials and resources can be developed, such as games, practical activities, and study guides, making learning more engaging and effective (Assunção *et al.*, 2022).
4. **Teacher Training:** Extension actions can include teacher training and development programs, helping them enhance their teaching practices and update their knowledge (Araújo & De Paulo, 2016).
5. **Teacher Training: Motivating Students:** Extension activities can ignite the interest and motivation of elementary school students for learning, making the process more engaging and meaningful (Túrmina & Rodrigues, 2016).
6. **Teaching Contextualization:** Extension activities can contextualize academic content, demonstrating how it applies to students' daily lives and the local reality (Biscard; Pereira-Santos; Silva, 2014).
7. **Strengthening Basic Education:** The partnership between the university and primary education enhances the educational system as a whole, promoting the quality of education and the appreciation of basic education (Pimentel, 2019).

Games can be a powerful didactic tool for teaching botany and other scientific disciplines (Costa; Miranda; Gonzaga, 2018). They have the ability to make learning more engaging, fun, and interactive for students (Costa, 2023), which can lead to a



deeper and more meaningful understanding of botanical concepts. Below, some points are highlighted to demonstrate the importance of games in botany education:

1. **Active Learning:** Games enable students to learn actively by actively participating in activities rather than being passive listeners in the classroom (Carneiro *et al.*, 2018). They need to make decisions, solve problems, and apply botanical knowledge in practice, which can improve information retention (Gregol *et al.*, 2021).
2. **Motivation and Engagement:** Games are inherently motivating and can increase students' engagement with the subject (Meirelles, 2022). By turning learning into a fun and challenging experience, students become more enthusiastic and willing to learn about botany.
3. **Practical Application of Concepts:** Games allow students to put into practice the theoretical concepts they have learned (Azevedo; Ramos; Benetti, 2021). This helps strengthen their understanding of botanical principles and their real-world application.
4. **Collaboration and Teamwork:** Many games are designed to be played in teams, encouraging collaboration among students (Silva Neto *et al.*, 2013). This collaboration can stimulate discussions about botanical topics, allowing students to learn from each other.
5. **Simulated Experiences:** Some botanical concepts can be challenging to visualize or understand through lectures and texts alone. Games can create simulated experiences that make it easier to grasp complex botanical phenomena (Tori *et al.*, 2020).
6. **Development of Cognitive Skills:** Games can help develop cognitive skills such as problem-solving, decision-making, logical reasoning, and critical thinking skills, all of which are essential for the study of botany (Ramos *et al.*, 2017).
7. **Significant Learning:** By presenting botanical concepts through practical and contextualized situations, games allow students to make meaningful



connections with the content (Retondar, 2011). This can lead to deeper and long-lasting learning.

8. **Stress Reduction:** The classroom environment can be intimidating for some students, and games offer a more relaxed and less stressful way of learning (Soares; Xavier; Soares, 2014). This can help reduce anxiety and increase students' confidence in studying botany.

Creating games by university academic extension students can be an extremely enriching and beneficial experience for these students, both academically and personally. Here are some reasons why game creation can be important for university students involved in extension activities:

1. **Practical experience:** By creating games, university extension students have the opportunity to apply the theoretical knowledge they have gained in their academic courses to a practical and concrete project (Digiampietri & Kropiwek, 2008). This practical experience can help solidify their learning and understanding of the concepts covered in their areas of study.
2. **Skill development:** Game development requires a variety of skills, such as creative thinking, problem-solving, teamwork, effective communication, and organizational skills (Bressan & Amaral, 2018). These skills are valuable not only for the game creation process but also for the professional development of university students in their future careers.
3. **Innovation and creativity:** Game creation is an activity that allows university students to express their creativity and innovation (Franco, 2009). They have the freedom to explore new ideas, concepts, and approaches to design games that meet the specific needs of extension audiences.
4. **Social impact:** Through game development in extension projects, university students have the opportunity to create educational and playful tools that can benefit the local community or other target populations (Pires; Fidelis; Martins, 2018) of the extension. These games can be used to disseminate information,



raise awareness of relevant social issues, or assist in teaching important skills and knowledge.

5. **Empowerment and leadership:** Engaging in the game development process can empower university extension students, allowing them to become leaders of meaningful projects. They can take on responsibilities, lead teams, and engage in decision-making activities, contributing to the development of their leadership skills (Brito; Mello; Araújo, 2011).
6. **Community Interaction:** Creating games for extension can involve direct interaction with the community or the project's target audience (Senna *et al.*, 2016). This interaction provides university students with the opportunity to better understand the needs and demands of the community and to create more relevant and effective games.
7. **Continuous Learning:** The process of game development is a journey of continuous learning (Barbosa Neto & Fonseca, 2013). Extension university students will encounter challenges and obstacles during the process, but they will also have the opportunity to learn from their experiences and improve their projects over time.

4. CONCLUSION

University extension actions are a two-way street that benefits both elementary school students and teachers and the involved university students. They promote the exchange of knowledge, enrich the teaching-learning process, and contribute to the improvement of basic education, strengthening the relationship between the university and the community.

The use of games as a teaching tool in botany can significantly enhance students' learning experiences, making the process more interesting, engaging, and effective. Furthermore, games provide a valuable opportunity for the practical application of



theoretical concepts, skill development, and creativity stimulation, all while students have fun learning about the fascinating science of plants.

Creating games for university academic extensionists goes beyond being just a recreational activity. It is an opportunity for students to apply their academic knowledge, develop important skills, innovate, and positively impact the community. By participating in this process, university students can become agents of social change and promote meaningful learning for both themselves and others.

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