

Bioeconomy Game: Sustainable Development in Your Home - A Proposal of Pedagogical Practices in Environmental Education in Brazil

Lorryanne Oliveira-Souza, Leonardo de Souza Carvalho, Sonia Cristina de Souza Pantoja, Anna Carina Antunes e Defaveri, Ygor Jessé Ramos, João Carlos da Silva

Socio-environmental Responsibility Center - Rio de Janeiro Botanical Garden Research Institute, Rio de Janeiro, RJ, Brazil.

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Abstract

This study aims to report the experience of developing and implementing an educational board game for environmental education with the goal of disseminating awareness practices. The game, called "Bioeconomy Game", is a way to stimulate learning through creativity and provide an opportunity to observe people's doubts about environmental education as well as the awareness generated in relation to anthropogenic impacts on nature. Therefore, it is important to raise awareness for both children and adults through playful activities.

Keywords— *Citizenship, Active Learning, and Sustainability.*

I. INTRODUCTION

Science subjects can be challenging for students, both at the elementary and secondary level, due to the complexity of the content. The themes often covered in science classes can be distant from students' everyday experiences. To address this challenge, didactic games have been developed as a way to facilitate learning in a playful and enjoyable way. These games help students learn basic concepts, develop logical reasoning skills, and foster creativity. Additionally, didactic games provide an opportunity for teachers to collaborate with students to facilitate learning (CUNHA, 1988; CAMPOS, 2003; GOMES et al., 2011).

Didactic or pedagogical games are a unique type of game designed specifically for learning. They differ from traditional educational materials because of their playful structure. They are used to meet specific educational goals and provide an alternative approach for students to better understand and perform on challenging content (CUNHA, 1988; CAMPOS, 2003; GOMES et al., 2011).

However, teachers do not often value didactic games because they are seen as more associated with entertainment than with actual learning. As a result, it may take some time for these games to be fully

accepted and there may be resistance to their use in the classroom (GOMES et al., 2001).

According to Miranda (2001), the use of didactic games can help achieve numerous objectives such as cognitive development, emotional development, motivation, socialization, and creativity. Cognitive development aims to enhance intelligence and personality, both of which are crucial for the development of thinking. Emotional development aims to foster sensitivity and self-esteem, and to strengthen relationships and connections. Socialization aims to stimulate group dynamics and work on social aspects. Motivation aims to promote action and awaken creativity through curiosity, encouraging students to explore new fields.

Such aspects make students more engaged and interactive in their learning environments. They become more excited and passionate about learning when they are exposed to playful and didactic activities, resulting in more meaningful learning (CAMPOS, 2003). This game was created by students of the administrative assistant with emphasis on sustainability course at the Socio-environmental Responsibility Center at the National School of Tropical Botany of the Botanical Garden of Rio de Janeiro, under the supervision of their professor. In addition to having been played during the National Week of Science and

Technology, the students also conducted a dynamic lecture on how to save money and adopt sustainable practices at home. These activities were linked to the construction of the game and the content being taught in class. The process of creating the game by the students themselves brings unique experiences and opportunities for learning, stimulating socialization and creativity. It not only develops the students but also promotes human development through educational action (DARSIE, 1996). The game was built based on the knowledge that the students were acquiring in the field of bioeconomy and environmental education, an important area of awareness.

The Socio-Environmental Responsibility Center (CRS) at the Botanical Garden Research Institute in Rio de Janeiro is an essential space for the dissemination of knowledge. It focuses on promoting student autonomy and learning through educational practices in the field of social and environmental research. The CRS provides professional training for young people aged 15 to 20 who are facing social vulnerability.

The objective of this work is to document the experience of creating and implementing a didactic board game during the National Week of Science and Technology at the Botanical Garden Research Institute in Rio de Janeiro, as a means of promoting environmental education.

II. METHODOLOGY

The game was developed by students from the Administrative Assistant with emphasis on sustainability course at the Socio-environmental Responsibility Center in Rio de Janeiro. These students were in their final year of high school, in all, 10 students participated in the process of creating the game. The game was implemented at the National Week of Science and Technology (SNTC) event, held at the arboretum of the Botanical Garden Research Institute in Rio de Janeiro.

Game Creation

The teacher of the course proposed the creation of the didactic game. The design and development of the questions were carried out by the students under the guidance of the teacher. The game is based on the topics studied during the environmental education portion of the course. The students used the Microsoft PowerPoint® program to create the game board and it was later printed on a print shop on a flexible PVC (polyvinyl chloride) board with a size of 90 by 60. To represent the game pieces, the students repurposed used PET (polyethylene terephthalate) bottle caps, made of polypropylene, and added a printed logo of the Botanical Garden of Rio de Janeiro as a sustainable alternative. As a reward for completing each portion of the path in the game, players received mock-up currency. To represent the dice in the game, the

students created small colored paper dice. The game created by the students can be seen in Figure 1.

Game Application / Play Mode:

The game board had a path that was divided and numbered from 01 to 40, indicating the way the player would follow. The divided portions were colored in yellow, light green, blue, and white, each corresponding to question cards of the same color. For example, when the player landed on a blue location on the board, the student would take a blue card and ask the question to the player. The questions were categorized into different levels: easy, medium, and difficult, to accommodate participants with varying levels of education and age. The answers to each question were provided on the cards to facilitate the dynamics between the students and the participants and to assure the students on the correct application of the game. Figure 2 shows the game and interaction between the students of the administrative assistant course with an emphasis on sustainability.

Formulation of Questions

Eighty-seven questions were prepared that related to everyday life and dealt with the theme of bioeconomy, sustainability, environmental education, and environmental impacts. The questions were written on A4 paper and later glued to cardboard in order to maximize their use in the game and minimize the cost of their preparation. In addition to questions about sustainability and environmental education, the game also had random bonus questions about sustainable actions that, in case the player had acted upon them during their daily life, they were also rewarded for making sustainable choices, for example, "Do you brush your teeth with the bathroom tap off?", if they did they'd be rewarded in-game with mock-up currency and moving to the next tile. The rules of the game were explained to each participant before they began playing. The participant who reached the end of the game first was declared the winner. Figures 3 and 4 show the questions included in the game.

Target Audience

The game was aimed at visitors present at the National Week of Science and Technology event at the Botanical Garden of Rio de Janeiro.

Number of players/Duration of the game/Prizes

The number of players can range from 2 to 6 and the game typically takes 20-30 minutes to complete. Each participant who reached the end of the game was awarded an eco-soap as a prize, the soap also sustainable produced in-house at the Socio-environmental Responsibility Center didactic laboratory of research in biodiversity, made by the same students of the course that applied the game.

Game Components

1 board, 6 pieces, 87 cards, 2 dice and 200 mock-up currency units.

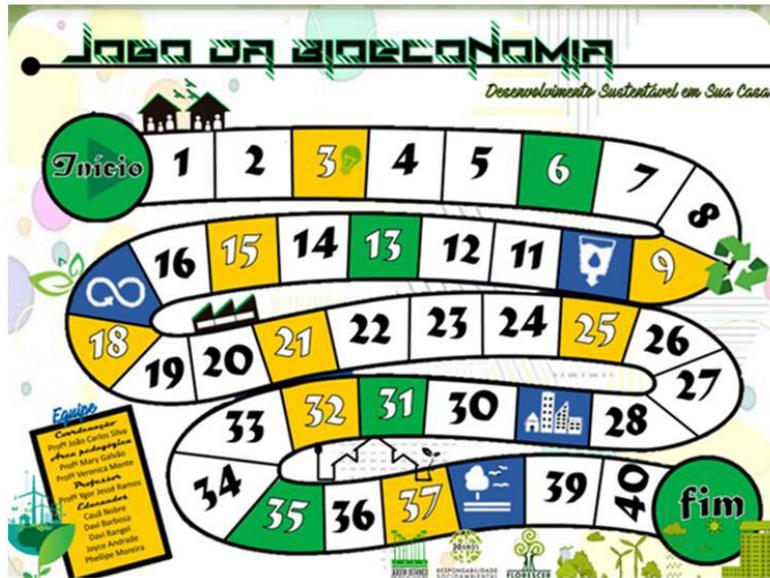


Fig.1: Didactic game “Bioeconomy game – Sustainable development in your home”.



Fig.2: Didactic game “Bioeconomy Game” – Sustainable development in your home” display of the game on the table.

<p>Which which vehicle below is more sustainable?</p> <p>(A) Boat (B) Ship</p>	<p>Is it more economical to buy wholesale or retail?</p> <p>(A) Wholesale (B) Retail</p>	<p>What can cause the lack of rain?</p> <p>(A) Dessertification (B) River pollution</p>
<p>Is it correct to dispose of medicines in toilets?</p> <p>(A) Yes (B) No</p>	<p>You were very sustainable, earn \$ 200 from the bank</p>	<p>You used a common light bulb and your bill came too high, pay R\$ 100.00 reais to the bank</p>

Fig.3: Some examples of game questions representing each symbol on the board.

BIOECONOMY GAME QUESTIONS			
YELLOW CARDS	BLUE CARDS	GREEN CARDS	BROWN CARDS
Which of the following elements is not used as an energy source? (A) Current water (B) Petroleum (C) Iron bar	What can cause the lack of rain? (A) Dessertification (B) River pollution	Is selective collection necessary? (A) Yes (B) No (C) Sometimes	What factors contribute to the accelerated urban growth in Brazil? (A) Rural Exit (B) Immigration (C) Urban Exit
If all companies were sustainable our country's economy: (A) Increases (B) Decreases	What can cause acid rain? (A) Release of pollutants into the air (B) Methane gases	Which of these is a method of environmental preservation? (A) Reforestation (B) deforestation (C) Distillation	The use of renewable energy decreases consumption of: (A) Gasoline (B) Ethanol (C) Fossils
What is the definition of liability in business economics?	Is it possible to reuse the water through the cistern? (A) Yes (B) No	Brazil is an example of recycling: (A) paper for school use (B) Aluminum cans (C) Plastic Bottles (PET)	What is the name of the gasoline that has a higher level of sustainability? (A) Diesel (B) Ethanol
Which lamp below is more economical? (A) Fluorescent lamp (B) LED lamp	What is the best way to save water in the washing machine? (A) Wash all clothes at once (B) Buy few clothes (C) Not to use	In which of the bins below do you dispose of the metal? (A) Yellow (B) Red (C) Green	When it comes to transportation, which of the options below is more sustainable? (A) Car (B) motorcycle (C) walking

Fig.4: Questions present on the card during the game following the color systems of the areas on the board.

III. RESULTS AND DISCUSSION

Perception of the students who created the game

Two students from the Administrative Assistant with emphasis on sustainability course at CRS report their experience regarding the design and construction of the game and the questions. This report can be seen below:

Student 1:

The way that was found was to play a game, a board game, where the children played the dice and each box had its information with questions, which we asked them and answered. Hit, walk; it didn't fit, it didn't walk. What was the point? yeah (...) they received information, they absorbed information and since it was a game and there was that feeling of "oh, that's cool!", let's play, everyone, competition", they absorbed the information to be able to pass it on, like "ah, so this is what happens, so okay, let's see if I can do it" then, that was the intention, you know, to get this information that we wanted to pass on, but in a lighter and cooler way too."

"Yeah (...), this activity, it was very important, it had an absurd relevance, at least in my life and that of the other girls too, I believe, right? Because knowledge is never too much and, this knowledge, and all this entertainment we had and all this plot of arriving, planning, having to study really in depth, you know, so you know."

Student 2:

What impact did the Bioeconomy Board Game have on me: It was the game that changed my life and made me look at the world in a different way. I was 15 years old and a teenager was not so aware that some acts were harmful or important for the environment, and with the game we could see that simple things make a total difference. I still apply this philosophy in my life today and I always try to share it with as many people as possible.

Lessons were presented as soon as we entered the JBRJ, where we observed ways to help the environment on all sides, such as: solar panels, trees of different characteristics, crystal clear water waterfall and several rules in case a visitor encounters an animal.

In fact, all this helped me a lot in my professional and personal progress, I became a better person just by practicing actions in favor of the environment. I remember that one of the ideas that was most reinforced in my theme (water preservation) was the creation of a cistern, without a doubt something that I carry in my head and philosophy to this day. Nowadays I see people around me doing everything to collect rainwater, many don't have the money to make or buy a cistern, but in the lecture we gave practical, efficient and economical ways of how to do it, and nowadays we see it being practiced it's a rewarding thing.

Game Application Experiences and Mediators' Perception:

The groups that participated in the game were composed of both children and adults. It was observed that both children and adults had many questions and curiosity about the topics presented in the game. Additionally, the game helped to clarify doubts they had about reducing costs in homes through environmental education. This interaction between participants and students aimed to prepare them for the challenges of the job market, developing teamwork in the development of the game and exposing them to

challenging situations such as public communication and team management. Figure 5 shows the moment of interaction with the game.

Throughout the game, it was evident that as the participants played, they became more aware of the environmental impacts that occur in their daily lives. Each time they made an unnecessary expense within the game, they received a fine, which caused them to reflect on their actions in daily life.



Fig.5: Application of the game to the general public and students interacting during the game's application at the Science and Technology Week in Rio de Janeiro, Brazil.

This process also helped to develop the students' autonomy and expand their knowledge of the subject. Researchers such as Dos Santos (2009) and Guimarães (2006) argue that education is achieved through action, thought, and practice through praxis, in interaction with others in the world. This highlights the importance of environmental education events that encourage community participation, as they promote individual awareness in society. Learning through didactic games concepts and practices related to environmental education is an interesting way, due to the environmental impacts that occur in nature (DOS SANTOS, 2009).

When participants won the game, they received as a gift soap made from the reuse of cooking oil made by students in the CRS/JBRJ laboratory under the supervision of a professor. Students told participants about the importance of reusing cooking oil to reduce environmental impacts.

IV. CONCLUSION

The development of the game by the students had positive results. The game helped to promote the students' autonomy by allowing them to put into practice the content they had learned. At the same time, it also sensitized them to environmental education practices in light of technological advances and environmental degradation. Thus, it is important to have such events that contribute to the students' active

participation in society and raise public awareness about environmental education.

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