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## ***Brazilian educational games for promoting adequate and healthy nutrition in schools: an analysis based on eduCAPES***

### **Jogos educativos brasileiros para promoção da alimentação adequada e saudável nas escolas: uma análise a partir do eduCAPES**

#### Abstract

Food and Nutrition Education (FNE) is a field of continuous and permanent knowledge and practices that is present in various sectors of society, with education being one of its main purposes. Various regulations support FNE, and schools should make use of the active educational approaches and resources recommended by the FNE Reference Framework for Public Policies. In this context, games can serve as a pedagogical tool for FNE. Considering that the eduCAPES portal is an important repository of Brazilian educational games, this article aims to identify and analyze those games which address the theme of nutrition, and discuss them in light of FNE Framework principles. This is a qualitative, exploratory, and descriptive study. The corpus consisted of games Disponível in the eduCAPES collection, accessed in May of 2023. Of the 331 games listed in the repository, 10 were selected for analysis. Initially, the games were analyzed in terms of narratives, general perceptions, keywords, and mechanics. Subsequently, these elements were related to the principles of the Framework. Three games addressed Principle I; two games were related to Principle II; one game addressed Principle III; six games were related to Principle IV; and one game showed an explicit relation to Principle V. In conclusion, more games need to be developed and more knowledge for this area needs to be produced considering both adequate game mechanics and the principles of the FNE Framework, together with official dietary guidelines as references.

**Keywords:** Food and Nutrition Education. Healthy Eating. Games.

#### Resumo

Educação Alimentar e Nutricional (EAN) é um campo de conhecimentos e de práticas contínuas e permanentes que está presente em diversos setores da sociedade, sendo a Educação um dos principais. Diversas normativas valorizam a EAN nas escolas, que deve fazer uso de abordagens e recursos educacionais ativos, como preconizado pelo Marco de Referência de EAN para Políticas Públicas. Nesse sentido, os jogos podem se constituir como uma ferramenta pedagógica de EAN. Considerando o portal eduCAPES como um importante repositório de jogos educativos brasileiros, este artigo tem como objetivo identificar e analisar aqueles que apresentam a temática da alimentação e discuti-los à luz dos princípios do Marco de EAN. Trata-se de um estudo qualitativo, exploratório e descritivo. O *corpus* foi composto por jogos disponíveis no acervo eduCAPES o qual foi acessado em maio de 2023. Dos 331 jogos listados no repositório, 10 foram selecionados para análise. Inicialmente, os jogos foram

analisados quanto às narrativas, percepções gerais, palavras-chave e mecânicas. Logo em seguida, esses elementos foram relacionados aos princípios do Marco. Três jogos abordam o princípio I; dois relacionam-se com o princípio II; um jogo aborda o princípio III; seis jogos relacionam-se com o princípio IV; e um jogo apresentou relação explícita com o princípio V. Enfim, indica-se a necessidade de que mais jogos sejam elaborados e mais conhecimento sobre esse tema seja produzido, considerando mecânicas adequadas e os princípios do Marco de EAN e dos guias alimentares oficiais como referenciais norteadores.

**Palavras-chave:** Educação Alimentar e Nutricional. Alimentação Saudável. Jogos.

## INTRODUCTION

Food and Nutrition Education (FNE) is "a field of continuous and permanent knowledge and practice, which is transdisciplinary, intersectoral, and multiprofessional, and aimed at promoting the autonomous and voluntary practice of healthy eating habits".<sup>1</sup> This definition was established with the publication of the FNE Reference Framework for Public Policies, positioning FNE as a strategy for implementing the second guideline of the National Food and Nutrition Policy (PNAN): the promotion of adequate and healthy nutrition.<sup>2</sup> As a field of knowledge and practice, FNE should be recognized as fundamental for developing autonomy and self-care and should be promoted across different sectors of society.

In this context, the various formal spaces within the education sector are configured as important environments for promoting healthy lifestyle practices. Schools are recognized as a privileged locus for promoting adequate and healthy nutrition, because they foster autonomy, participation, critical thinking, and creativity.<sup>3</sup> Moreover, they allow addressing issues such as self-esteem and positive behavioral changes.<sup>4</sup>

These premises have been encouraged by various Brazilian public actions, and with yet greater emphasis since publication of Interministerial Ordinance No. 1.010 of May 8, 2006, which established guidelines for the Promotion of Healthy Eating in early childhood, primary, and secondary education schools in public and private networks in Brazil.<sup>5</sup> Additional legislation was subsequently published to encourage schools to promote FNE actions, such as Law No. 11.947 of June 16, 2009, of the National School Feeding Program (PNAE), which presents FNE as one of the guidelines for school feeding<sup>6</sup> in its Article 2, and Law No. 13.666 of May 16, 2018, which amended Law No. 9.394 of December 20, 1996 (National Education Guidelines and Bases Law) to include the cross-cutting theme of food and nutrition education in the school curriculum.<sup>7</sup>

The publication of regulations that value FNE in the school environment is important for addressing these themes in schools. However, the challenge of qualifying the educational actions recommended by these laws remains. To this end, the FNE Framework indicates that

the practice of FNE should employ problematizing and active educational approaches and resources that foster dialogue with individuals and population groups considering all stages of the life course, phases of the food system, and the interactions and meanings that shape eating behavior.<sup>1</sup>

In this sense, games stand out as methodological strategies that can be an important active pedagogical tool in the challenge of promoting adequate and healthy eating in schools. Such games are played within certain time and space limits, according to agreed-upon but mandatory rules. They have an end in themselves and are accompanied by the awareness that they are different from everyday life. It is possible to find societal values in games, and they themselves can be seen as cultural elements, and as having a social function;<sup>8</sup> issues that involve the theme of Food and Nutrition.

When games have an educational or motivational objective, they can be referred to as educational or "serious" games. Yet despite the label, they should not lose their fun and entertainment value.<sup>9</sup>

In Brazil, we find published experiences regarding the use of games in FNE, such as that of Mercante et al.,<sup>10</sup> which describe experiences of vocational high school students using games in partnership with Physical Education, Sociology, and Geography teachers in FNE activities. The authors emphasized that the action created a space for dialogue within the school community, and for more dynamic and interactive activities. Another experience involved the development and use of the game *Rango Cards*, applied with groups of

adolescents in private schools in the Federal District. The game demonstrated the potential of this strategy for changing eating behaviors in this audience.<sup>11,12</sup>

Games are increasingly being used in various areas of education, and there is a noticeable expansion of their production and application in health fields.<sup>13</sup> Given the rise of these creations within educational, research, and extension institutions, the eduCAPES portal, which was established in 2016, announced a new version in 2023, and incorporated games into its collection of educational tools (texts, books, articles, theses, dissertations, video lectures) for use in basic, higher, and postgraduate education.<sup>14</sup>

Considering this platform as an important repository of actions developed in Brazilian educational spaces, this article aims to identify and analyze the games cataloged on the eduCAPES portal that feature the theme of Food and Nutrition. The article then seeks to discuss and critically examine the production of educational games in light of the principles of the FNE Framework.

## METHOD

This is a qualitative, exploratory, and descriptive study, whose corpus consisted of games available in the eduCAPES collection. For data collection, the eduCAPES portal was accessed on May 2<sup>nd</sup>, 2023 followed by organization and analysis of the games (until May 15<sup>th</sup> of the same year). Initially, the search filters of the portal in the "games" tab were used, and the following keywords were searched: "food", "nutrition", and "eating". However, it was noticed that many of the search results were unrelated to the keywords used, indicating that for a better user experience, the portal's search filters and perhaps the descriptors chosen should be reviewed.

All 331 games available in the eduCAPES collection were considered. They were all pre-analyzed and sorted based on the information page for each game present on the portal and the available files. From the total number of games, those related to the theme of Food and Nutrition were selected as potential resources to be used for FNE actions in schools.

The games included were grouped into categories in accordance with the conceptual principles of the FNE framework. The theoretical framework used to guide discussion of the results consisted of the first five principles of FNE<sup>1</sup> as declared in the Framework, and which possess a conceptual focus:

- I- Social, environmental, and economic sustainability;
- II- Approaching the food system in its entirety;
- III- Valorization of local food culture and respect for diversity in opinions and perspectives, and considering the legitimacy of knowledge of different natures;
- IV- Food and nourishment as references; Valorization of cooking as an emancipatory practice;
- V- Promotion of self-care and autonomy.

In addition to these, the Framework also brings forth four additional principles:

- VI- Education as a permanent process and generator of both autonomy and the active and informed participation of individuals;
- VII- Diversity in practice;
- VIII- Intersectorality;

IX- Planning, evaluation, and monitoring of actions.

The four principles above (VI-IX) were not used as categories of analysis since they are more procedural and attitudinal in character. Beyond this methodological decision, we emphasize the cross-cutting nature and importance of these topics in the planning and evaluation of FNE actions, including those developed using the games identified in the study.

The games were analyzed following Bardin's<sup>15</sup> content analysis, which consists of a set of techniques used in message analysis, and involves three stages: 1) pre-analysis: initial contact with the text, usually carried out with a floating reading of the material; 2) exploration of the material: coding operations, with the choice of units of analysis and data categorization; 3) treatment of the obtained results followed by interpretation: the results are treated in order to become more meaningful, with proposals concerning inferences, production of tables and diagrams, and other elements. Since games do not present textual elements alone, we adapted the analysis technique above, and after searching on the eduCAPES portal, the games were listed, described, and analyzed based on their elements (presentation texts, booklets, game boards, pieces, rules of the game). The games included were analyzed in regard to their narratives, and general perceptions (related to the use of the Food Guide as a reference, and presence of important and complex food and nutrition themes, including an aesthetic evaluation), keywords, and mechanics used (the mechanisms, objectives, rules, and actions of the game, and how the players should relate to them).<sup>16</sup> These elements were then observed and associated with the principles of the FNE Framework. This analysis, which consisted of interpretative work, was carried out by a single researcher, this was followed by a review performed by a second researcher.

## RESULTS AND DISCUSSION

In total, 11 games related to the themes of food, nutrition, and eating were found. However, one of these games, "*On the Trail of Healthy Eating*", was excluded from the analysis because it did not permit associations with the principles of FNE (this was because the documentation published on the eduCAPES site did not include all of the components, such as the game cards).

Thus, a total of 10 games were selected for analysis, of which seven presented food and nutrition education as one of the keywords: (*Eat what?; Food and Nutrition Education - The Game; To Eat or not to Eat? A Game about Non-Conventional Food Plants (PANC); Balance Tower ; (Getting to know food (again); Playing with Letters; and Which food is it?*) (Table 1).

Only one game (an educational game that addresses body issues - *Metamorfose*) addresses the theme of the body. Two games (*Environmental Battle*, and *Playsticide*) bring sustainability using keywords. The game "*To Eat or not to Eat? A Game about Non-Conventional Food Plants (PANC)*" addresses biodiversity, which is related to sustainability (Table 1).

As to the game mechanics:

Four games used a trail format (*Eat what?; Food and Nutrition Education - The Game; To Eat or not to Eat? A Game about Non-Conventional Food Plants (PANC); and Playsticide*);

Three games used questions and answers (*Food and Nutrition Education - The Game; Which food is it? and Environmental Battle*);

Two games were association games (*Getting to know food (again); and Playing with Letters*).

One game was built using role-playing game - (RPG) mechanics (*Educational Game to Address Body Issues - Metamorfose*),

One game involved stacking and balancing (*Balance Tower - Balancing Your Diet*) (Table 1).

As to direct relationships with the principles of FNE, the most prominent theme was "*Food and nourishment as references; Valorization of cooking as an emancipatory practice*" (six games) (Table 1).

The results are summarized in Table 1. The problematization and discussion of the games found on the eduCAPES portal follows both the Table and the categories evaluated..

**Chart 1.** Summary of the Analysis of the eduCAPES Collection with the Theme of Food and Nutrition.

Title	Access link	FNE Principles	Keywords	Narrative and objectives	Main game mechanics	Perceptions
Environmental battle	<a href="https://educapes.capes.gov.br/handle/capes/586617">https://educapes.capes.gov.br/handle/capes/586617</a>	I- Social, environmental and economic sustainability	Games; Professional and Technological Education, Sustainable Development, educational resources	Acquire knowledge about the Sustainable Development Goals through a competition with questions and answers	Questions and answers	Addresses topics of specific interest to FNE, such as eradicating poverty; zero hunger and sustainable agriculture; health and wellness; clean water and sanitation. However, the choice of the “questions and answers” mechanic makes the game just an interactive support for the proposition of content.
Playing with letters	<a href="https://educapes.capes.gov.br/handle/capes/564323">https://educapes.capes.gov.br/handle/capes/564323</a>	IV- Food and nourishment as references; Valorization of cooking as an emancipatory practice	Food and nutritional education  Nutrition  Pedagogical practices in health  Educational game  Healthy eating  Health	Match food figures with their initial letters, and whoever accumulates the most chips wins	Association game	Allows several ways to play and can be a way for children to become familiar with food. It does not use the Food Guide as a reference and can dichotomize foods into healthy and unhealthy.

Chart 1. Summary of the Analysis of the eduCAPES Collection with the Theme of Food and Nutrition (Continues)

Title	Access link	FNE Principles	Keywords	Narrative and objectives	Main game mechanics	Perceptions
To eat or not eat? A game about Non-Conventional Food Plants (PANC)	<a href="https://educapes.capes.gov.br/handle/capes/642398">https://educapes.capes.gov.br/handle/capes/642398</a>	I- Social, environmental and economic sustainability; III- Valuing local food culture and respecting the diversity of opinions and perspectives, considering the legitimacy of knowledge of different natures; IV- Food and nourishment as references; Valorization of cooking as an emancipatory practice	Non-Conventional Food Plants (PANC) Professional and Technological Education Food and Nutritional Education	The player must travel the path of the board, along which he acquires information or must answer questions about the PANC. Win by placing all parts at the point of arrival.	Card - trail game	Card trail game Features attractive aesthetics; approach to a topic little discussed in FNE actions. Use of design tricks (surprise cards, question cards, joker cards) associated with “questions and answers”, which can generate the feeling that the game works only as an interactive way of working on content. Does not use the Food Guide as a reference.
Eat what?	<a href="https://educapes.capes.gov.br/handle/capes/723280">https://educapes.capes.gov.br/handle/capes/723280</a>	IV- Food and nourishment as references; Valorization of cooking as an emancipatory practice	Food and Nutritional Education Health Promotion	The player must help the character “Ômago” to follow a food trail, making good food choices and staying away from processed foods.	Card - trail game	Uses the Food Guide as a reference; features design tricks (cards with questions, drawing activities or mimes) that make the game more interesting. But in some of the game cards you can see a dichotomy between healthy and unhealthy foods.
Food and Nutrition Education - the Game	<a href="https://educapes.capes.gov.br/handle/capes/723277">https://educapes.capes.gov.br/handle/capes/723277</a>	II- Approaching to the Food System in its Entirety	Food Education Nutritional Education Educational Game Healthy eating Obesity	The player must follow the trail, which represents the route of the food, from the countryside to the city.	Trail game with questions and answers	Uses the Food Guide as a reference. However, it does not allow many actions or strategies.



**Chart 1.** Summary of the Analysis of the eduCAPES Collection with the Theme of Food and Nutrition (Continues)

Title	Access link	FNE Principles	Keywords	Narrative and objectives	Main game mechanics	Perceptions
Educational game to address body issues – “ <i>Metamorfose</i> ”	<a href="https://educapes.capes.gov.br/handle/capes/717442">https://educapes.capes.gov.br/handle/capes/717442</a>	V- The promotion of self-care and autonomy	Physical Education High school The Human Body in Education	With players divided into groups, they must take on character roles, follow the narrations, and from there, debate the theme of “body perception” in society.	RPG	Demonstrates the different functions of the body, in addition to aesthetics
Playsticides - pesticides and sustainable agriculture	<a href="https://educapes.capes.gov.br/handle/capes/581365">https://educapes.capes.gov.br/handle/capes/581365</a>	I-Social, environmental and economic sustainability; II- Approaching to the Food System in its Entirety	Pesticides Pesticide Environment Sustainability Sustainable Agriculture Toxicity	The player is a farmer who will be able to differentiate the toxicity of pesticides, know their active ingredients and know the main activities of farmers. The objective is to encourage support for sustainable agriculture	Card - Trail Game	Use of different design tricks (luck or setback, bonuses and information about pesticides) that can make the game more interesting
Which food is it??	<a href="https://educapes.capes.gov.br/handle/capes/564306">https://educapes.capes.gov.br/handle/capes/564306</a>	IV- Food and nourishment as references; Valuing cooking as an emancipatory practice	Food and nutritional education Pedagogical practices in health Nutrition Educational game	Enhance and develop the knowledge of schoolchildren and adolescents about fresh foods from question cards with tips.	Questions and answers	Uses the Food Guide as a reference, but most of the questions are easy and may generate a lack of interest among teenagers
Getting to know food (again)	<a href="https://educapes.capes.gov.br/handle/capes/564330">https://educapes.capes.gov.br/handle/capes/564330</a>	IV- Food and nourishment as references; Valorization of cooking as an emancipatory practice	Food and Nutrition Education Nutrition Pedagogical practices in health Natural food Processed foods Ultra-processed foods	The player must associate each food figure with its correct degree of processing (fresh, processed, ultra-processed)	Association game	Uses the Food Guide as a reference. Explains differences between degrees of food processing.

Chart 1. Summary of the Analysis of the eduCAPES Collection with the Theme of Food and Nutrition (Continues)

Title	Access link	FNE Principles	Keywords	Narrative and objectives	Main game mechanics	Perceptions
Balance tower - Balancing Your Diet	<a href="https://educapes.capes.gov.br/handle/capes/571879">https://educapes.capes.gov.br/handle/capes/571879</a>	IV- Food and nourishment as references; Valorization of cooking as an emancipatory practice	Food and nutritional education  Healthy eating  Educational game  Nutrition  Health Promotion	Adaptation of the game “Jenga”, which consists of removing pieces from a wooden tower without them falling and according to instructions on cards, generating associations of which foods to consume and which to avoid.	Stack and balance	Is fun and provides cognitive development, but presents a dichotomy between healthy and unhealthy foods. Uses the Guide as a reference.

## FNE PRINCIPLES

### Principle I - Social, Environmental, and Economic Sustainability

The first principle of the FNE Framework considers that sustainability plays a central role in the many stages of the food system, it extends beyond environmental dimensions to encompass human and socioeconomic relations. This ensures that FNE promotes adequate and healthy eating without sacrificing natural resources and is guided by ethics, justice, equity, and sovereignty.<sup>1</sup> This principle was evident in three games: "Playsticide - Pesticides and Sustainable Agriculture", "Environmental Battle", and "To Eat or not to Eat? A Game about Non-Conventional Food Plants (PANC)". The first two games highlight sustainability as keywords, while the latter focuses on FNE and addresses the theme of biodiversity, which also relates to sustainability.

As revealed in Principle I of the Framework, sustainability and environmental issues should be addressed in FNE actions. This is also in line with the Brazilian Food Guide's principle that "Adequate and healthy eating derives from a socially and environmentally sustainable food system." <sup>17</sup>

In the game "To Eat or not to Eat?," players navigate through the board game, similar to Ludo (a classic game which features a board divided into four differently colored areas, each occupied by a player whose objective is to take four pawns to the center of the board first), collecting information and answering questions to acquire knowledge about Non-Conventional Food Plants (PANC), which are typically undervalued native species with limited use.<sup>18</sup> This game allows players to recognize different plant species from the Brazilian biodiversity and foster dialogue about the presence and absence of these foods in both territories and people's diets, as well as the uses and importance of biodiversity for individuals and their environment.

The games "Playsticide - Pesticides and Sustainable Agriculture" and "Environmental Battle" were not specifically designed to promote adequate and healthy eating. They were created by professionals from other fields of knowledge, such as Biology, and are aimed at teaching the same as well as Environmental Education. However, considering their relation to the first principle of FNE, during the analysis we observed that they could be applied for this purpose.

In Playsticide, the player assumes the role of a farmer and navigates through the board game to learn about the toxicity of pesticides, identify their active ingredients, and understand the main activities of farmers through informative cards, luck (or setback cards), and bonuses. With this approach, the game's creators aim to promote support for sustainable agriculture. It is worth noting that the theme of food production and contamination by pesticides should be discussed with various audiences since it is a significant barrier to the exercise of the human right to adequate and healthy food.<sup>19</sup>

"Environmental Battle" is a question and answer game based on the Sustainable Development Goals (SDGs) that covers various topics of specific interest to FNE, such as eradicating poverty, zero hunger, and sustainable agriculture, health and well-being, and clean water and sanitation.<sup>20</sup> In schools, SDGs can be discussed in various high school curriculum components. This game can be used to include food and nutrition issues as a cross-cutting theme, for example, in Geography and Philosophy classes.<sup>21</sup>

### Principle II - Approaching the Food System in its Entirety

"Food and Nutrition Education - the game" is one of the resources that directly relates to the second principle of FNE, which states that the food system encompasses access to resources such as land and water,

as well as production, processing, supply, trade, distribution, choice, food consumption, and waste disposal. FNE actions should consider all of these dimensions.<sup>1</sup>

The game is a board game with questions and answers, where the trail represents a journey from the countryside to the city, depicting various stages of the food system such as production, distribution, and commerce. The game "Playsticide" also aligns with this principle in its narrative by exploring the stages of food production through sustainable agriculture.

The principle is of utmost importance because knowledge about the diversity of food systems and how it affects the environment and population health raises awareness about commercial determinants of food and nutrition.<sup>22</sup>

### **Principle III - Valuing local food culture and respecting the diversity of opinions and perspectives, considering the legitimacy of knowledge from various sources.**

The third principle of the FNE draws attention to Brazilian food as a cultural and historical expression, as well as its regional peculiarities. This principle considers that FNE should encompass the diverse practices and knowledge of traditional peoples and communities, as well as different dietary choices, such as those of people with special dietary needs.<sup>1</sup>

Only the game "To Eat or not to Eat? A game about Non-Conventional Food Plants (PANC)" relates to the third principle of the FNE. It presents unconventional food plants found on rural properties in a community in the municipality of Xique-Xique, Bahia, and addresses not only biodiversity, but cultural diversity as well. These two elements are related and interdependent. Each culture has its own sets of representations, knowledge, and practices, and human activity in the environment is a cultural expression. Thus, "we cannot understand and conserve the natural environment unless we understand the human cultures that shape it."

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Understanding the diversity of food culture in the context of FNE actions can lead to an appreciation of local foods and traditional cooking methods. This can achieve the guidelines present in the "Food guide for the Brazilian population", such as making fresh and minimally processed foods the basis of the diet and developing culinary skills.<sup>17</sup>

### **Principle IV - Food and nourishment as references; Valorization of cooking as an emancipatory practice**

By introducing PANCs, To Eat or not to Eat? A game about unconventional food plants, (also relates to principles I and III), focuses on foods, their uses, properties, and cultural significance. Additionally, it also presents ways to cook such plants, relating to principle IV of the FNE, which indicates that we do not just consume nutrients, but rather foods and preparations loaded with cultural, social, affective, symbolic, and sensory values, and which as addressed in FNE bring people closer to real-life experiences and establish connections. In this principle the FNE emphasizes the importance of cooking, an activity that fosters autonomy and expands the individual's range of possibilities. It should be discussed and valued in educational actions, even when actual food preparation is not possible.<sup>1</sup>

"Eat what?" is a board game with cards in which the player must help a character named Ômago to travel along the trail, making appropriate food choices and avoiding ultra-processed foods. Depending on the space landed on, participants must answer questions about food, perform charades, or draw something.

The focus is on food, its nutritional properties, and health benefits, as well as its level of processing and sensory characteristics.

On the other hand, "Balance tower - Balancing Your Diet" is an adaptation of the commercial stacking and balancing game called Jenga. According to the rules and instructions revealed on cards each round, players remove pieces from a wooden tower and must keep it balanced. Associations are made between which foods to consume and which to avoid, and in accordance with meal times.

In "Getting to know food (again)" the participant selects a picture of a food item and must correctly place it on a banner that presents three columns with the degrees of food processing: fresh, processed, and ultra-processed. The winner is the one with the most correct placements.

"Playing with letters " is recommended by the authors for players aged five and older, but may be uninteresting for older children and adolescents. In fact, we highlight the importance of games having a recommended age range (a piece of information that was not present in any of the other analyzed games) so that the game can be used effectively. This game involves matching pictures of foods with their initial letters, which is interesting for schoolchildren who are in the process of learning to read and write. Additionally, since foods are central elements, it can also help children become familiar with them. However, care must be taken to avoid presenting the foods in a way that dichotomizes them into healthy and unhealthy categories.

Finally, "Which food is it?" is a question-and-answer game in which one participant draws a card with various clues about foods (nutritional, sensory, most consumed moments), while another participant must guess what food it is. The aim is to enhance and develop knowledge in children and adolescents, mainly about fresh foods.

Although these games are built around foods rather than their nutrients, one weakness observed was the lack of attention given to sociocultural aspects and symbols. However, except for "Playing with letters" and "To Eat or not to Eat?", all of the other games related to Principle IV - ("Eat what?", "Balance tower", "Getting to know food (again)", and "Which food is it?") used the Food Guide as a reference for their development.

While the Food Guide was created to serve as support and encouragement for healthy eating practices, whether individually or collectively,<sup>17</sup> it does not guarantee complex FNE actions, nor avoid the weaknesses, and the dichotomy between healthy and unhealthy foods observed in some elements of these games. The Food Guide seeks to move away from nutritional reductionism, diminishing the role of nutrients as the basis for health communication and guidance, while redirecting the focus to foods. This measure is aligned with the FNE Reference Framework, and incorporated into these games can be seen as an advantage.

However, this does not mean to say that nutrients are unimportant. There is no doubt that carbohydrates, proteins, fats, vitamins, and minerals are indispensable to humans, but there is a problem in reducing food and nutrition to nutrients. Pollan<sup>24</sup> reminds us that in the 1980s, supermarket shelves were full of packages, boxes, and bags of groceries that highlighted a select group of nutrients on their labels. Instead of familiar names like eggs, breakfast cereals, and snacks, colorful labels began to present: "cholesterol", "fiber", and "saturated fats". However, today we know that nutrients, in isolation, are not responsible for longevity and health, and there needs to be an effort for FNE activities to move away from nutritionist logic and address eating as a complex phenomenon.

### Principle V - Promotion of self-care and autonomy

The "Educational game to address body issues – "Metamorfose"" specifically addresses Principle V - Promotion of Self-Care and Autonomy, which conceptualizes self-care as actions directed towards oneself or the environment to regulate one's functioning and generate well-being, empowering individuals to make behavioral changes focused on personal development and health empowerment.

The game's keywords include "Physical Education," "High School," and "Human Body in Education," and it is an RPG (role-playing game) where players assume various roles, which enables discussions about the body. Through this dynamic, the game explores diverse aspects of the body beyond aesthetics and societal standards.

This is crucial in FNE since alongside obesity and hunger, other problems can affect schoolchildren including dissatisfaction with body image, and risk behaviors for the development of eating disorders, such as taking medication to lose weight, eating less than necessary, restricting calories, avoiding foods high in fat, and practicing excessive physical exercise, among others.<sup>25</sup> These issues mainly affect adolescents and it is known that greater concern about the body and negative body image can be associated with depressive symptoms, low self-esteem, greater dietary restriction and avoidance of physical activity.<sup>26</sup> Reflecting on body representations in contemporary society through the game "Metamorfose" can contribute to adequate self-care and a positive body image.

Moreover, this principle may be implicitly present in other educational games, as they, to some extent, aim for autonomy and self-care by acquiring knowledge about nutrition.

### Game Mechanics

The game mechanics were generally simple and limited. We emphasize the two most commonly found in the nutrition and food-related games on eduCAPES: trail-based games and question-and-answer games.

In trail-based games, players typically move their game pieces or markers along a trail on a board, aiming to reach the end first, with challenges or actions on the board's spaces that may benefit or hinder the player. "The Game of Life" is one of the most well-known examples of this type. On the other hand, in question-and-answer games, such as "Trivial Pursuit" or "Trivia Master" players answer questions to earn points or advance along a trail on a board, similar to trail-based games.

While these mechanics are commonly used in educational games or serious games in general, they can be problematic, as pointed out by La Carretta.<sup>9</sup> The idea of using question-and-answer formats or "quiz games" in an educational game is appealing, but it can lead to the game functioning as a support or interactive system relying heavily on participants' prior knowledge. In other words, the game may be reduced to simply a more interactive way of presenting content.

Similarly, trail-based game mechanics are often chosen for their simplicity but may not allow much room for strategy. Therefore, the inclusion of what is known as "design tricks," challenges, and solutions, is crucial to make the game more engaging and enjoyable.<sup>9</sup> This can be seen in games like "Playsticides", "To Eat or not to Eat? A Game about Non-Conventional Food Plants (PANC)" and "Eat what?" which feature luck and setback cards, bonuses, wildcards, and activities that require multiple skills.

La Carretta<sup>9</sup> indicates the need for developers of educational games to build repertoires of games, meaning they should play various games to become familiar with a wide range of mechanics and thus choose those most suitable for the theme and audience they wish to target. The author notes that not all educators

are adept game developers, and it's important to seek assistance from game designers, other professionals, and individuals experienced in these methodologies.

Further, it's worth noting that despite the names "educational games" or "serious games," a game should not forego its entertainment character. It's necessary for it to also be "useless," as highlighted by Caillois<sup>27</sup> and Huizinga.<sup>8</sup> This may seem paradoxical, but the game should be "useless" in the sense that it stimulates relaxation and enjoyment, opposing the perception of work, and being sustained solely by the pleasure felt in playing it.<sup>27</sup>

In this sense, games, even when used in schools, (spaces involving duty and obligation), should be constructed to break away from time and space.<sup>8</sup> This playful strategy should create temporary worlds within the habitual world, providing a space that diverges from the solemnity of the traditional classroom by creating another reality through a narrative that temporarily overlaps time and space.<sup>28</sup>

Moreover, considering that people do not all learn in the same way, games can be engaging tools that provide an assimilation of reality, learning of content, as well as motor, emotional, and social development; all while engaging the player in an enjoyable activity.<sup>29</sup>

## CONCLUSION

In this research, we emphasize the potential of the eduCAPES portal, which aims to disseminate educational material, and which by making a vast educational collection available to the public, can be seen as a tool to support Food and Nutrition Education (FNE). However, due to its difficulties, it is important to revise its search functions to benefit all users accessing its content.

We also highlighted the importance of using FNE as a cross-cutting theme in education (as recommended by Law No. 13.666),<sup>7</sup> and to integrate it with public policies and programs related to health, such as the School Health Program (PSE), established by Decree No. 6.286 of December 5, 2007<sup>30</sup> (which includes the promotion of adequate and healthy nutrition among its 17 listed actions); the already mentioned National School Feeding Program (PNAE), which presents FNE as one of the guidelines for school feeding;<sup>6</sup> and the Bolsa Família Program, recreated by Law No. 14.601 of June 19, 2023,<sup>31</sup> which aims to achieve its objectives through articulation with health, education, social assistance programs and actions, among others.

Due to its cross-cutting, intersectoral nature and its relation to various areas of knowledge and practice settings, as well those stated within the FNE Framework, it is also important that FNE does not become an exclusively nutritionist activity. Health professionals, the school community, and the social development sector, among others, should engage in FNE activities, as well as accessing its training and continuing education programs.<sup>1</sup>

Regarding the analyses conducted with the nutrition-themed games found on the eduCAPES portal, one game was eventually excluded from the analysis due to the impossibility of relating it to the principles of the FNE Framework. This resulted in a total of 10 games that relate to Principles I, II, III, IV, or V.

Some of the games were built in reference to the Food Guide for the Brazilian Population. This is seen as strength, despite the perceived presence of questionable elements such as the dichotomy between healthy and unhealthy foods.

However, a noted weakness is that the game mechanics were often simplistic and lacked variety. This suggested the limited repertoire of the authors, and highlighted the need for nutrition educators to collaborate with professionals with greater experience in game mechanics.

To produce greater knowledge, It is essential that more games are developed, this, considering the appropriate mechanics and knowledge, as well as addressing the principles of the FNE Framework and the Food Guide.

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### Contributors

Dantas RF participated in the conception of the work, data analysis and interpretation, writing, and review; Vale D participated in the conception of the work, writing, review, and approval of the final version; Costa JSG and Andrade RA participated in the conception of the work, review, and approval of the final version.

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