

QUAIS SÃO OS INTERESSES DOS ESTUDANTES EM PLANTAS, ALIMENTAÇÃO E SAÚDE?

WHAT ARE STUDENTS' INTERESTS IN PLANTS, FOOD, AND HEALTH?

¿CUÁLES SON LOS INTERESES DE LOS ESTUDIANTES EN LAS PLANTAS, LOS ALIMENTOS Y LA SALUD?

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Resumo

Associar o ensino da biodiversidade à saúde é uma forma de engajar os estudantes na preservação ambiental. Assim, os objetivos desta pesquisa foram: identificar quais são os interesses dos alunos sobre o tema plantas alimentícias e compreender as possibilidades e desafios de estimular o interesse dos estudantes com o material didático relacionado ao tema. Um total de 45 estudantes de 11 a 14 anos do estado de São Paulo (Brasil) responderam a um questionário em escala Likert de quatro pontos antes e depois de usar o material, o qual foi submetido à análise estatística e inferencial. Os dados revelam que o material didático fomentou o interesse dos estudantes por plantas alimentícias, biodiversidade nativa e diversidade de flores, folhas e frutos. Esta pesquisa contribuiu para definir o perfil de interesse dos estudantes e indicou que integrar biodiversidade e saúde pode estimular os alunos no ensino de Botânica.

Palavras-chave: Botânica; Ensino de Ciências; Biodiversidade; Disparidade na percepção de plantas.

Abstract

Associating the teaching of biodiversity with health is a way to engage students in environmental preservation. Therefore, the objectives of this research were: to identify students' interests in the topic of edible plants and to understand the possibilities and challenges of stimulating students' interest with teaching materials related to the topic. A total of 45 students, aged 11 to 14 years old, from the state of São Paulo (Brazil) answered a four-point Likert scale questionnaire before and after using the material. The questionnaire was subjected to statistical and inferential analysis. The data reveals that the teaching materials fostered students' interest in edible plants, native biodiversity, and the diversity of flowers, leaves, and fruits. This research contributed to defining the students' interest profile and indicated that integrating biodiversity and health can stimulate students in the teaching of Botany.

Keywords: Botany; Science teaching; Biodiversity; Plant Awareness Disparity

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Resumen

Asociar la educación sobre biodiversidad con la salud es una forma de involucrar a los estudiantes en la preservación del medio ambiente. Así, los objetivos fueron: identificar cuáles son los intereses de los estudiantes sobre el tema de las plantas comestibles y comprender las posibilidades y desafíos de estimular sus intereses con material relacionado con el tema. Un total de 45 estudiantes, de 11 y 14 años de São Paulo (Brasil), respondieron un cuestionario de escala Likert de cuatro puntos antes y después de usar el material, que fue sometido a análisis estadístico e inferencial. Datos revelan que el material fomentó el interés de los estudiantes por las plantas alimenticias, la biodiversidad nativa y la diversidad de flores, hojas y frutos. Esta investigación contribuyó a definir el perfil de interés de los estudiantes e indicó que la integración de la biodiversidad y la salud puede estimular la enseñanza de la botánica.

Palabras clave: Botánica; enseñanza de las Ciencias; Biodiversidad; Disparidad en la percepción de las plantas

Introduction

Viruses, bacteria, animals, plants, and other organisms, including us *Homo sapiens*, are elements that are in constant interaction. These interactions indicate that humans, plants, and animals are closely connected, which can be interpreted in a *One Health* perspective. This may seem non-trivial at first glance due to the complexity of the interconnections. Humans, plants, and animals share the same environment, and environmental changes, such as deforestation and climate change, directly affect everyone who shares this habitat. This interaction makes it possible to systematically understand how these three groups of organisms mutually influence each other, guiding more effective prevention and surveillance practices. Although the *One Health* approach is not a new concept, it has been expanded in recent years to demonstrate the interconnection and inseparability between human, other animals, and environmental health. This concept allows us to comprehend that human-wildlife contact can result in the transmission of zoonotic diseases such as: ebola, avian flu, swine flu, zika virus, and covid-19 (Barrett et al., 2011; I Joly; Queiroz, 2020; Alho, 2012).

Zoonoses are diseases that come from animals and migrate to humans and comprise about 65% of infectious diseases that affect humans. Unfortunately, diseases of zoonotic origin have been on the rise due to accelerated deforestation, illegal wildlife trafficking, and climate change. Therefore, to avoid the spread of new diseases and epidemics, it is necessary to preserve biodiversity (Barrett et al., 2011; Val, 2021).

Nature provides a wide range of benefits through ecosystem services (Martins; Sano, 2009). Such services are classified into: provision (characterized by providing products from the ecosystem, i.e., fruits, vegetables, and medicinal resources), regulation (benefits from natural resources, for example, regulation of air quality and water purification), cultural (characterized by including non-material benefits, i.e., recreation and aesthetic values), and support (responsible for sustaining other ecosystem services, i.e., in the cycling of nutrients and maintenance of biological diversity) (Vezzani, 2015). In this way, by cutting down trees, human beings affect these ecosystem services and put their own health at risk, as there is a connection between human health and the preservation of biodiversity (Val, 2021). Not only have charismatic and attractive megafauna been losing their habitat, but also organisms that are mistakenly considered non-living beings (Barman et al., 2006; Lindemann-Matthies, 2005).

Even though plants are the basis of life on planet Earth, they are seen only in the background, as a habitat for animals, not only in schools, but in “cartoons, movies, books, toys and games filled with thousands of anthropomorphic animal characters” (Hershey, 2002, p. 83). Hershey (2002) comments that one of the few known anthropomorphic vegetable characters is Mr. Potato Head, who appears in Toy Story by Disney.

According to Gagliano (2013), since Ancient Greece, plants were seen as inferior, and currently one of the factors that contributes to the neglect of plants is that the teaching of Botany is in a vicious cycle. Most of the time, the initial training of science teachers in the field of Botany is uninspiring and, as a result, they fail to encourage students’ interest in plants. Consequently, those students who decide to become teachers will probably remain uninterested in Botany and fail to motivate their future students to learn about botany. In addition to this cycle, the lack of interest that both teachers and students show for Botany can make the teaching authorities eliminate this theme from the curriculum. Freitas, Vasques, and Ursi (2021) analyzed documents guiding Brazilian basic education and realized that Botany content decreases throughout the stages of basic education. This means that there is a greater appreciation of botanical content in kindergarten and elementary school than in high school.

In 1999, this difficulty in identifying and naming plants received the term Plant Blindness, coined by Wandersee and Schussler (1999). The term proposed by these authors was more closely related to cognitive aspects and human visual perception than to the depreciation of Botany by students and teachers. Thus, this term has a neurophysiological origin in information processing by the brain. However, this term has been criticized because it “equates a disability (blindness) with a negative or undesirable trait (being unaware of and apathetic toward plants) and is therefore ableist” (Parsley, 2020, p. 599). Therefore, to replace this term, Parsley (2020) suggests “Plant Awareness Disparity” (PAD). Ursi and Salatino (2022) suggest the term “botanical imperception.” In our research, we adopted the term “Plant Awareness Disparity”, as the word “disparity” highlights precisely the difference in perception between animals and plants in the environment, which is Parsley’s (2020) intention and this term has been used in international research (Walton et al., 2023; Brownlee; Parsley; Sabel, 2021; Burke et al., 2022).

Moreover, research in the context of the ROSE project (The Relevance of Science Education) has verified the low interest of students in Botany. The ROSE project is an international survey that investigates students’ interests in aspects of Science and Technology (S&T). In Brazil, ROSE was applied for the first time in 2007. The purpose of ROSE is to collect and gather data from students to identify their motivations and interests in aspects of S&T, meaning ROSE pays attention to the “voice of students” (Jenkins, 2006; Gouw, 2013). Internationally, we have research in Israel (Trumper, 2006), Germany (Elster, 2007), and England (Jenkins; Pell, 2006), among other countries, while in Brazil we can highlight the work of Gouw (2013) and Tolentino Neto (2008). In summary, as already mentioned, these surveys have shown that students are uninterested in learning about Botany, which contributes to some misunderstandings of botanical concepts. Among these misconceptions, we can mention the research by Barman et al. (2006) who found that American children did not recognize grass as a plant, as it did not produce flowers. Also, according to Barman et al. (2006), more than half of the participants classified mushrooms as plants rather than a fungi. The author believes that this may have happened due to an association

between mushroom stems and the plant stems.

Given this appreciation for vegetables, in this research, we focused on educational interventions in the classroom about plants. There are two ways to combat plant neglect: (1) through teaching; and (2) through the media (Salatino; Buckeridge, 2016). In teaching, one way to increase admiration for a topic considered boring and boring is “the production of interesting texts and articles on current topics related to Botany and biology teaching” (Salatino; Buckeridge, 2016, p. 193). Thus, in this research we aim to contemplate the questions: what are the themes of biodiversity that most and least interest Brazilian students from Baixada Santista in the Coast of São Paulo? What are the possibilities and challenges of using didactic material to encourage student interest?

Furthermore, as we intend to analyze the students’ interests, we emphasize that there is a difference between personal interest and situational interest. According to Mitchell (1993), personal interest is the interest that a person brings to a particular context or environment. In other words, students arrive in the classroom interested or not interested in certain content. On the other hand, situational interest is something acquired in a given context or environment. Thus, teachers have control only over situational interest. Mitchell (1993) says that situational interest is divided into catching interest and holding interest. Catching interest consists of stimulating a student to be interested in a piece of content, while holding interest is about making the content relevant to a student. Certainly, holding students’ interest is the challenge for teachers (Elster, 2007).

In this fashion, to stimulate students’ interest in Botany, we defend an association between education for biodiversity and health education because research (Franzolin et al., 2021; Santana et al., 2022) has identified that students were more interested in learning about biodiversity when there was an association with health aspects. Given these considerations, this study aims: 1) to identify what the students’ interests on the subject of food plants are; and 2) to understand the possibilities and challenges of fostering students’ interest in using didactic material³ designed for this theme.

Methodology

This research was submitted and approved by the ethics committee (CAEE nº 67968217.5.0000.5594), and data was collected from students aged 11 to 14 years. In total, 45 students (29 girls and 16 boys) from four schools located in the Baixada Santista of the state of São Paulo participated in this research.

Participants responded to 15 items using a four-point Likert-type scale, where 1 means “not interested”; 2 “little interested”; 3 “very interested”; and 4 “extremely interested”. Thus, answers with an average above 2.5 indicate a lot of interest, below 2.5 little interest, and answers closer to 4 indicate extreme interest. We emphasize that we opted for a four-point Likert scale instead of the typical five-point Likert scale to avoid the occurrence of neutral responses (Gouw, 2013). Some of the questionnaire items that were used for data collection were based on ROSE items, and others

¹ The didactic material is available on a freely accessible website for teachers upon prior registration.

were elaborated and validated by the research group.

The 15 items were into four categories: “biodiversity in the world and medicine” (which included biodiversity items contextualized with their use in medicine), “biodiversity in the world and food” (which included biodiversity items contextualized with their use in food), “diversity of organisms” (which included items about plants, animals, and microorganisms without contextualization of their use in medicine, in food, or for other ends), and “native biodiversity and food” (which included items with the word “native” in context).

In total, students answered two questionnaires: one before using a didactic material on food plants and another after using the material. The time interval between these questionnaires was approximately one month. There was no specific methodological criterion for choosing this time frame; the availability and internal planning of the participating school mainly determined it. This choice, while necessary to enable the research to proceed, has the limitation of not allowing us to understand whether the construction of knowledge is persistent in the long term, which will require future research that can follow the students over a longer period. We highlight that our intention in this article is not to address the material used in full. Thus, just for contextualization purposes, we briefly describe the topics present in the material. The material comprises 21 pages and is divided into six sections, which are: 1. Plants, Food, and Biodiversity; 2. *Tropaeolum pentaphyllum* (common name: “Crem”, in Portuguese “batata-crem”); 3. *Anredera cordifolia* (known worldwide as “Madeira vine”, in Portuguese “bertalha coração”); 4. *Xanthosoma* sp. (common name: “Yautia”, in Portuguese “taioba”); 5. Kinship relationships between the studied families; and 6. Complementary materials.

The first section is introductory and raises questions about the monotony of Brazilian food based on the consumption of a few species, most of which are exotic. In the next three sections, three species of plants with food potential are discussed. It explains the morphological aspects, nutritional properties, distribution in the Brazilian territory, and information about scientific research produced in Brazilian public universities about these species. In the penultimate section, to promote the reflection that the studied species are connected since they come from a common ancestor, a phylogenetic tree was inserted with the three families of the studied plants (Araceae, Basellaceae and Tropaeolaceae). The last section has additional resources that teachers can use with their students, such as a conceptual map with the main topics covered throughout the material, a catalog of images of food plants, basic information on cultivation, and proposals for investigative activities. A total of four teachers made themselves available to use the didactic material with their students.

This article only analyzes the return of the students’ interests. The 45 students were not divided into groups corresponding to their teachers, as the objective was to analyze the potential of the material and not the way in which it was used. Although we know that the potential of the material is directly related to the way in which the teacher uses it, in this study we defend the teachers’ autonomy. The aim was to provide teachers with didactic possibilities on the topic of food plants based on scientific information without taking away their autonomy. In this way, teachers could use the material as they wished (in parts, as a whole, or even adapt it) and in as many classes as they had available (Lombard; Weiss, 2018).

Regarding our sample, this is considered non-probabilistic for convenience, as data was

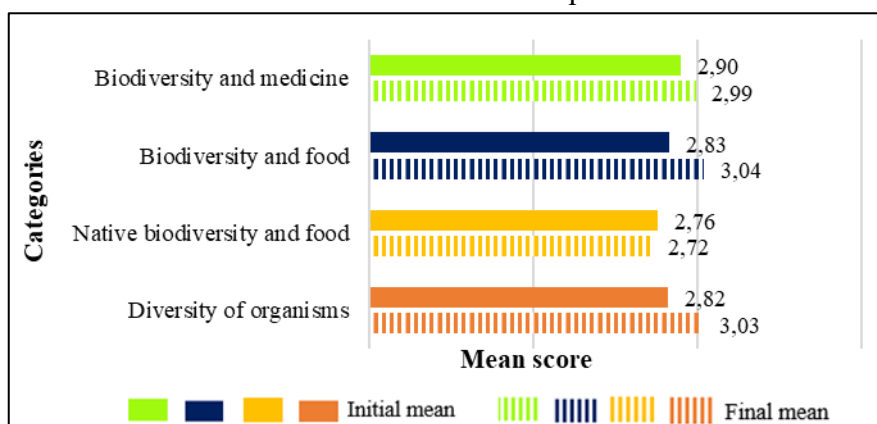
collected through the availability of teachers to use the material and of the students' guardians to sign the Term of Free and Informed Consent as the students were underage. The data from the questionnaires was submitted for descriptive and inferential statistical analyses. The data was tabulated in *Microsoft Office Excel* spreadsheets and then transferred to R software version 4.3.0. Descriptive statistics provided the mean (\bar{x}) and standard deviation (SD) for each of the 15 items and each category. Inferential statistics used a non-parametric model for ordinal variables with repeated measures (Rosa, 2001) and non-linear models with mixed effects (Kutner et al., 2004).

For the 15 items, a non-parametric model was used for ordinal variables with repeated measures (Rosa, 2001) because the data did not have a normal distribution. In this model, gender and time are explanatory variables, and the interaction between these two variables was also considered. The effect of each student was considered random since, in the study, measurements were taken on the same students at different times. Gender and moment were considered fixed factors. The model compares the frequency distribution using Wald statistics, and a significance level of 5% was adopted. Thus, the frequency distribution of the 15 items was compared in relation to: moment (comparison of responses before and after using the material), gender (comparison of responses between boys and girls), and the interaction between these two variables (gender and moment). For the analysis of categories, as the variables are quantitative, linear models with mixed effects were used (Kutner et al., 2004). For each model (referring to each category), a residual analysis was performed that showed a good fit (Nobre; Singer, 2007) and again, gender and moment were considered fixed factors.

Results

In Figure 1, we have the mean score of the categories in the initial and final questionnaires and in Figure 2, the items of each category. The colors of the items represented in figure 2 correspond to the colors of their respective categories in Figure 1.

Figure 1 - Mean score of students' interests in categories of items related to biodiversity in the initial and final questionnaires.



Source: created by the authors.

Both in the initial and final questionnaires, we realized that students were interested in all established categories, as their averages were above 2.5. In the initial questionnaire, the category of greatest interest was “biodiversity in the world and medicine” ($x = 2.90$, $SD = 0.01$), while the one of least interest was “native biodiversity and food” ($x = 2.76$, $SD = 0.06$) (Figure 1). Regarding the final questionnaire, the category of greatest interest was “biodiversity in the world and food” ($x = 3.04$, $SD = 0.08$), and the one of least interest remained “native biodiversity and food” ($x = 2.72$, $SD = 0.04$) (Figure 1).

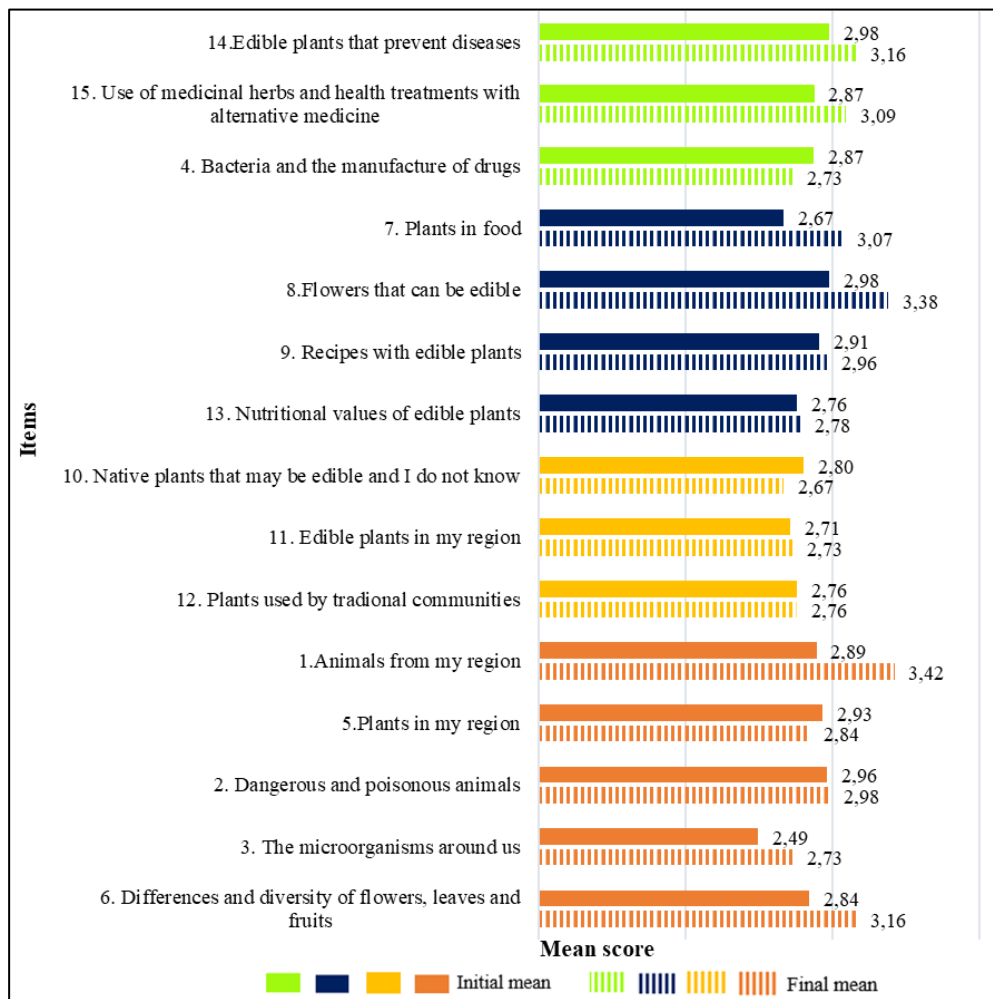
Of the items in the “biodiversity in the world and medicine” category (Figure 2), the one with the highest average was “14. Edible plants that prevent disease” both in the initial ($x = 2.98$, $SD = 1.08$) and final ($x = 3.16$, $SD = 1.04$) questionnaires. On the other hand, the one with the lowest average in both questionnaires was “4. Bacteria and the manufacture of drugs” (before: $x = 2.87$, $SD = 1.08$; after: $x = 2.73$, $SD = 1.27$). However, in the initial questionnaire, this item had an average equal to item “15. Use of medicinal herbs and health treatments with alternative medicine” ($x = 2.87$, $SD = 1.06$).

In the category “biodiversity in the world and food”, item “8. Flowers that can be edible” had the highest average in the initial questionnaire ($x = 2.98$, $SD = 1.10$) as well as in the final questionnaire ($x = 3.38$, $SD = 1.01$). The item with the lowest average in the initial questionnaire was “7. Plants in food” ($x = 2.67$, $SD = 0.93$), while in the final questionnaire it was “13. Nutritional values of edible plants” ($x = 2.78$, $SD = 1.18$).

In the category “native biodiversity and food”, item “10. Native plants that may be edible and I do not know” was the one with the highest average ($x = 2.80$, $SD = 1.10$) in the initial questionnaire. But in the final questionnaire, this item had the lowest average ($x = 2.67$, $SD = 1.15$). The other two items in this category “11. Edible plants in my region” (before: $x = 2.71$, $SD = 1.16$; after: $x = 2.73$, $SD = 1.19$) and “12. Plants used by traditional communities” (before: $x = 2.76$, $SD = 1.00$; after: $x = 2.76$, $SD = 1.11$) had similar means in both questionnaires.

Finally, in the category “diversity of organisms”, in both questionnaires the items with the highest averages were related to animals. In the initial questionnaire, it was item “2. Dangerous and venomous animals” ($x = 2.96$; $SD = 1.07$), while in the final questionnaire it was item “1. Animals in my region” ($x = 3.42$, $SD = 0.89$). Also, in both questionnaires, the item with the lowest average in this category was “3. The microorganisms around us” (before: $x = 2.49$, $SD = 1.06$; after: $x = 2.73$, $SD = 1.12$). In addition, in this category, we noticed an increase in the average of the item “6. Differences and diversity of flowers, leaves, and fruits” (before: $x = 2.84$, $SD = 0.93$; after: $x = 3.16$, $SD = 1.07$).

Figure 2 - Mean score of students' interests in items related to both questionnaires.



Source: created by the authors

In Table 1, the mean score of each item for girls and boys can be seen. In addition, in relation to inferential statistics, Table 2 shows p-values for the Wald test.

Table 1 -Mean score of boys and girls in each item before and after using the material.

Items	BEFORE				AFTER			
	Mean		Standard deviation		Means		Standard deviation	
	♀	♂	♀	♂	♀	♂	♀	♂
14. Edible plants that prevent diseases	3.21	2.56	1.01	1.09	3.31	2.88	1.04	1.02
15. Use of medicinal herbs and health treatments with alternative medicine	2.93	2.75	1.13	0.93	3.17	2.94	1.14	1.12
4. Bacteria and the manufacture of drugs	3.10	2.44	1.11	0.89	2.69	2.81	1.28	1.28
7. Plants in food	2.59	2.81	0.98	0.83	3.03	3.13	1.12	1.09
8. Flowers that can be edible	3.00	2.94	1.13	1.06	3.59	3.00	0.78	1.26
9. Recipes with edible plants	2.97	2.81	1.12	1.11	3.00	2.88	1.20	1.15
13. Nutritional values of edible plants	2.97	2.38	1.02	0.88	2.72	2.88	1.22	1.15
10. Native plants that may be edible and I do not know	3.00	2.44	1.04	1.15	2.83	2.38	1.10	1.20
11. Edible plants in my region	2.66	2.81	1.17	1.17	2.76	2.69	1.30	1.01
12. Plants used by traditional communities	2.79	2.69	1.01	1.01	2.79	2.69	1.08	1.20
1. Animals from my region	2.79	3.06	0.94	0.92	3.52	3.25	0.78	1.06
5. Plants in my region	2.76	3.25	0.87	0.93	2.66	3.19	1.32	0.98
2. Dangerous and poisonous animals	2.90	3.06	1.11	0.96	3.00	2.94	1.22	1.24
3. The microorganisms around us	2.66	2.19	0.97	1.17	2.62	2.94	1.15	1.06
6. Differences and diversity of flowers, leaves and fruits	2.76	3.00	0.92	0.96	3.17	3.13	1.00	1.20

Source: created by the authors

Table 2 indicates that a difference was found when comparing the frequencies in relation to the moment for the items: “1. Animals from my region”, “7. Plants in food”, and “8. Flowers that can be edible”. In these items, the students’ interest increased after using the material in a statistically significant way (p values equal to 0.004, 0.038, and 0.0019, respectively). As for item “14. Edible plants that prevent disease”, it was the only one that reported a difference between the responses of girls and boys (p = 0.0017). Girls are more interested in this item than boys, both before and after using the material (Table 1). Item “3. The microorganisms around us” stands out due to the interaction effect between gender and moment (p = 0.048).

Table 2 - p-value for the Wald test in the comparison of frequency distributions.

Items	p-value		
	Interaction	Gender	Moment
14. Edible plants that prevent diseases	0,647	0,017	0,251
15. Use of medicinal herbs and health treatments with alternative medicine	0,973	0,291	0,253
4. Bacteria and the manufacture of drugs	0,054	0,263	0,899
7. Plants in food	0,799	0,525	0,038
8. Flowers that can be edible	0,202	0,244	0,019
9. Recipes with edible plants	0,946	0,576	0,611
13. Nutritional values of edible plants	0,051	0,373	0,403
10. Native plants that may be edible and I do not know	0,767	0,094	0,562
11. Edible plants in my region	0,357	0,991	0,888
12. Plants used by traditional communities	0,930	0,717	0,896
1. Animals from my region	0,165	0,934	0,004
5. Plants in my region	0,842	0,057	0,909
2. Dangerous and poisonous animals	0,584	0,898	0,800
3. The microorganisms around us	0,048	0,808	0,066
6. Differences and diversity of flowers, leaves and fruits	0,509	0,586	0,062

Source: created by the authors

Note: Moment= comparison of responses before and after using the material. Gender = comparison of responses between boys and girls. Interaction = association of the two variables, gender and moment. Items with significant differences are marked in bold.

Table 3 points out a difference in the frequency distributions of the two moments just for the male gender. This indicates that after using the material, boys became more interested in this item. For the categories, there was no effect of moment, gender, or interaction between gender and moment (Table 4).

Table 3 - p-value for the Wald test in the comparison of frequency distributions of two moments for item “3. The microorganisms around us”.

Gender	p-value
Girls	0,919
Boys	0,011

Source: created by the authors

Table 4 - p-value for comparison of category means.

Categories	p-value		
	Interaction	Gender	Moment
Biodiversity in the world and medicine	0,324	0,052	0,898
Biodiversity in the world and food	0,913	0,558	0,182
Native biodiversity and food	0,879	0,537	0,884
Diversity of organisms	0,823	0,432	0,062

Source: created by the authors

Note: Moment = comparison of responses before and after using the material. Gender = comparison of responses between boys and girls. Interaction = association of the two variables gender and moment.

Discussion

Results indicate that before using the material the category with the highest average was “biodiversity in the world and medicine”, but after using the material the category with the highest average became “biodiversity in the world and food”. Despite this difference not being statistically significant (Table 2), data indicates that the material may have made the students more interested in the subject of biodiversity and food, and this could be positive for students to develop a more preventive and less curative view of biodiversity. It means that the perspective that biodiversity is just a means to cure diseases (curative vision) can be expanded to a perspective of providing food that is vital for human survival and that can also prevent diseases, even before they occur (preventive vision).

Studies carried out by Franzolin et al. (2021) show that students were more interested in learning about biodiversity in items related to health or human utility, with some of these items related to medicinal plants. In our research, this interest was also corroborated because the item “14. Edible plants that prevent diseases”, was the one that presented the highest average before and after the application of the material in the category “biodiversity in the world and medicine”. Going further, in our research, we found that students are also interested in learning about food plants, and the didactic material fostered this interest in students since item “7. Plants in food” had a statistically significant increase (Table 2).

We warn that information on plant biodiversity cannot be summarized only in terms of its usefulness, that is, consumption items of human interest, either medicine or food. Based on the students’ interest in the importance of biodiversity for human health, the intrinsic, inherent, and immeasurable values of biodiversity should be fostered. Otherwise, this utilitarian view of biodiversity by itself can contribute to the perpetuation of the anthropocentric view (the use of nature by human beings). To understand that human beings are just one more living being among the other living beings in biodiversity (biocentrism), it is necessary to understand that biodiversity provides basic elements, and not simply products for the survival of the human being and other species (Martins; Sano, 2009; Calegari et al.,2021).

Moreover, we noticed that this interest of the students in food plants enabled an increase in an item related to plants, which is “6. Differences and diversity of flowers, leaves, and fruits” (before: $x = 2.84$, $SD = 0.93$; after: $x = 3.16$, $SD = 1.07$). Although this increase was not statistically significant, this is an indication that the didactic material, by linking food and health, may have contributed to the students’ interest in botany. Therefore, we suggest that educational proposals that address botany content include the theme of food plants, as it was something that can influence the students’ interest, contributing to mitigating the disparity in the perception of plants. In our research, we also detected that this disparity in attention is not just a phenomenon “inter” groups of living beings but “intra” groups; that is, within the group of plants, there is an appreciation of flowering plants, called angiosperms. This may be the result of a stereotyped view of the morphology of plants with representations of flowers and fruits (Barman et al., 2006; Silva; Ghilardi-Lopes, 2014; Knapp, 2019). This is evident, since item “8. Flowers that can be edible” was the one that presented the highest average in the category “biodiversity in the world and food” in both questionnaires.

From the data obtained, we also found that item “10. Native plants that may be edible and I do not know” had a small decrease in the average in the final questionnaire. Added to this, the category “native biodiversity and food” was the only one in which there was a slight drop in the average. Even though these decreases are not statistically significant (Table 2), we emphasize that the participants were students interested in learning about native biodiversity, as the averages were above 2.5. This data differs from the studies by Franzolin, Garcia and Bizzo (2020) who found that the average interest of students in the Southeast region in learning about native plants was 1.58 ($SD = 0.64$). Additionally, these authors indicated that, compared to students from the Southeast region, students from the North region of Brazil had a greater interest ($x = 3.18$, $SD = 0.71$) in learning about plants from their region due to the strong influence of indigenous culture in this region.

Therefore, we believe that data from the category “native biodiversity and food” deserves to be further explored in future studies to verify whether we would have similar results, as this was a challenge for the didactic material. We need to understand what students understand by the terms native, local, and regional biodiversity. For the students, are native species only those present in their backyard, neighborhood, or school? For instance, Proença, Dal Farra, and Oslaj (2017), in their research, ascertained that some students from the South region defined native species as “they are in our houses”, “they are in the forests”, “they are easy to find” (2017, p. 224), while exotic species were related to be rare, unknown, and strange. Still, according to the data from these authors, students recognized several species that were presented to them; however, they did not know how to identify which were native and which were exotic.

In this fashion, one hypothesis is that, as we chose food species that were not widely known, students may have mistakenly associated them with rare species. As previously mentioned, the three species of plants present in the material were: *Tropaeolum pentaphyllum*, *Anredera cordifolia* and *Xanthosoma* sp. According to their geographic distribution, these three species occur in the state of São Paulo; nevertheless, it may be that these three species are not easily accessible to students. We emphasize that promoting students' interest in native plants is a challenge not only in Brazil, as Trumper (2006), in this study in Israel, Elster (2007), in Germany

and Australia, and Jenkins and Pell (2006), in England, also found that students had little interest in learning about plants in their region. Despite this challenge, the didactic material made it possible to hold the situational interest of the students in relation to native biodiversity, and Mitchell (1993) points out that holding interest is more difficult than catching interest.

Regarding the category “diversity of organisms”, in descending order, students indicated a greater interest in items related to animals, plants, and microorganisms, which we already expected due to the literature (Hershey, 2002; Freitas; Vasques; Ursi, 2021; Jenkins; Pell, 2006; Tolentino-Neto, 2008). However, we noticed that after using the material there was an increase in item “6. Differences and diversity of flowers, leaves, and fruits” (before: $x = 2.84$, $SD = 0.93$; after: $x = 3.16$, $SD = 1.07$), as previously mentioned. Santana et al., (2022) identified that students had low interest in the item “how scientists study plants” ($x = 2.50$; $SD = 1.00$) when compared to the item “how scientists study animals” ($x = 3.07$; $SD = 0.96$). Thereby, it is necessary to bring students closer to the process of building scientific knowledge so that the teaching of science, in this case of plant biodiversity, becomes more significant. In the didactic material, we incorporated elements of the Nature of Science (NOS) through clippings of scientific research with the names of the researchers, research questions, and the way of data collection and analysis in order to bring the school culture closer to the scientific culture. The insertion of the NOS may also have contributed to the increase in item “6. Differences and diversity of flowers, leaves, and fruits”.

Still in the category “diversity of organisms”, it was found that after using the material the boys were more interested in item “3. The microorganisms around us” (Table 3). The theme of microorganisms was not the focus of this research, so we indicate that future research with larger samples or with a longer period of use of the material may help to determine whether this data is a trend because the didactic material did not address this topic.

Moreover, a statistically significant difference was found between boys and girls for item “14. Edible plants that prevent diseases” (Table 2). In this item, the girls showed greater interest before and after using the material (Table 1). Research (Jenkins; Pell, 2006; Jidesjo et al., 2009; Tolentino-Neto, 2008; Pinafo, 2016; Gouw; Mota; Bizzo, 2014) point out that students are more interested in human biology topics related to health and disease in Brazil, England, Sweden, Finland, Italy, Estonia, Denmark, and Israel. However, girls are more interested in aspects of aesthetics and beauty than boys (Elster, 2007). This may explain the fact that the girls showed a greater interest in learning about plants that prevent disease, as they are interested in keeping the body healthy and preventing disease. Complementing this, ethnobotanical studies (Furlan et al., 2017; Freitas et al., 2012) indicate that in traditional communities, women are the main caregivers of backyard gardens containing plants for medicinal, food, and/or ornamental purposes, and possess the greatest knowledge. The attribution of the concept of caregiving to women is due to a social and cultural construct. In popular tradition, knowledge about native vegetation is passed down from generation to generation, and usually, the guardian is a woman. Thus, it is important to discuss that the act of caring for backyard gardens is not a strictly female task, as the preservation of culture and knowledge should be seen as a relevant activity for the entire community, regardless of gender.

Conclusion

This research contributed to defining the profile of interest of Brazilian students from the state of São Paulo on the coast of Baixada Santista about plant biodiversity and indicated the possibilities and limitations of a didactic material on food plants. Regarding interests, we found that students were interested in aspects related to health not only for medicinal plants but also for edible plants. From these interests, other biodiversity values can be fostered, so the instrumental/utilitarian value can be seen in a mutual and non-antagonistic way in the teaching of plant biodiversity. Starting from the theme of food plants, not only the nomenclature and morphology of plants can be addressed, but also the appreciation and recognition of the Brazilian flora, evolutionary aspects of plant biodiversity, nutritional properties of plants, among other subjects, thus contributing to the understanding of the intrinsic value of biodiversity.

In relation to the possibilities of the material, these were: (I) it fostered more students' interest in food plants, thus contributing to a more preventive and less curative view of biodiversity; (II) it held students' situational interest in native biodiversity and food; and (III) the theme of food plants seems to generate greater interest among students in the diversity of flowers, leaves, and fruits, but more research is needed to confirm this trend. One of the material's challenges was to increase the students' interest in native biodiversity; we believe that future research is necessary to understand what students understand by native biodiversity.

We consider that it is an analysis of the use of only one didactic material on the theme of food plants, and in the short term, due to the scope of this research, we were able to verify some possibilities and challenges. Investigating students' interests helps in the learning process because – by bringing these interests closer to scientific content – it helps students understand the need to preserve megabiodiversity not only of charismatic and visually attractive species but also of all species present in ecosystems. The preservation of ecosystems is directly related to human health, as the loss of biodiversity due to deforestation, climate change, and overexploitation of natural resources, among other factors, increases the exposure of the human species to pathogens, allowing the emergence of new zoonoses. Thus, introducing content with topics related to students' interests, connecting them with others that are not interesting to them can broaden their knowledge about biodiversity so that they understand not only the instrumental value of biodiversity, but also the intrinsic value. It can help students understand complex situations so that they can make responsible decisions that affect individual and collective health.

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