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Students' Interests in Biodiversity: Links with Health and Sustainability

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Abstract: The COVID-19 pandemic has shown that sustainable actions to preserve biodiversity are critical to preventing new microorganisms from harming human health. In this sense, education and encouraging young people's interest in local biodiversity are crucial to promoting its preservation and sustainability. This research studied the biodiversity interests of 14–15-year-old students in São Paulo State, focusing on the links between biodiversity and human health. The criterion of maximum variation was used to constitute a heterogeneous sample of students. Students answered a four-point Likert questionnaire. The items in this questionnaire were divided into categories related to the interest of young people in biodiversity, and these were analyzed using descriptive and inferential statistics (Wilcoxon test). Categories of biodiversity linked to "health or human utility" were of higher interest to young people than those with no links to human benefits, such as "diversity of organisms". These findings, along with the literature, showed that young people are interested in biodiversity issues associated with human health. Therefore, teaching biodiversity should reflect on new possibilities for making a more sustainable environment and promoting social and environmental justice, fundamental aspects of promoting and guaranteeing human health.

Keywords: pandemics; biodiversity preservation; secondary school; biology education

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1. Introduction

The COVID-19 pandemic has raised broad discussions on the different dimensions involved in promoting and guaranteeing human health, including the importance of biodiversity. Initially, the zoonotic virus SARS-CoV-2 was transmitted from a mammal to humans [1], an extreme example of the connection of the environment with human health. Most infectious diseases, such as HIV, MERS, SARS, H2N, measles, smallpox, diphtheria and Ebola, are caused by zoonotic viruses, potentially transmitted to humans by other vector animals, domestic, wild, or in captivity [2,3]. Although many of the zoonoses come from animal domestication, a newly emerging risk is the appearance of new diseases due to the increase in population and its impact on ecosystems [3].

In Brazil, the first case of COVID-19 confirmed by the Ministry of Health was in February 2020, and by August 2021, the country recorded more than twenty million cases and almost 600,000 deaths [4]. Of this large amount, São Paulo State (the focus of this research) had the highest number of cases (over 4 million) and deaths (over 145,000) [4]. In the São Paulo city, the analysis of the disease incidence and mortality is higher in the Black and Brown populations living in the poorest districts (Bom Retiro, Brasilândia, Cidade

Ademar, Cidade Tiradentes, Grajaú, Guaianases, Iguatemi, Itaim Paulista, Jaraguá, Jardim Angela, Lajeado, Marsilac, Parelheiros, Parque do Carmo, Pedreira, Perus, São Rafael, Vila Curuçá and Vila Jacuí), where there is a greater housing density of inhabitants in the houses (>3.07 resident/household) and among those over 60 years of age [5]. As poverty increases, there is an increase in the mortality gradient [5]. Furthermore, the city of São Paulo, as well as other cities in the state of São Paulo (Jaboticabal, Bragança Paulista, Presidente Prudente, Marília and Adamantina) are geographic hubs due to the highway networks and the heavy traffic of people and goods, making them potential reservoirs and foci for spreading the disease [6]. Thus, on the one hand, the pandemic showed the inhumane and vulnerable situation in which a large portion of the São Paulo (and Brazilian) population finds itself; and on the other hand, it invites reflection on how to confront it, which must consider the social, political, and economic situations, and forms of environment management.

Given these considerations, researchers argue that biodiversity conservation is essential to prevent new risks to human health and new pandemics [2]; however, the view that biodiversity health is linked to human health is not new and has been identified in many indigenous communities for over 10,000 years [3,7]. Despite this, such perception disappeared with the anthropocentric view, promoted by religions that place man in a central position and other organisms at his service, and also by the industrial revolution [3]. More recently, those earlier ideas concerning human health and the environment have been taken up again and are on todays' agenda. The conceptual framework of human health and sustainable environment is founded on ecology, concerning human and other organisms' health and well-being, and the interconnectedness of the global environment [3]. In other words, human health is linked to biodiversity preservation.

Biodiversity can be defined as the variety of organisms at different levels, considering the genetic diversity among organisms of the same species, the diversity of species, genera, families, and other higher taxonomic groups, as well as the diversity of ecosystems, which includes the diversity of organisms and the diversity of physical conditions of the habitat in which they live [8]. It is composed of the following levels: (i) species diversity, resulting from biological evolution; (ii) genetic diversity, which encompasses the diversity of genetic information (genes and chromosomes); and (iii) ecological diversity, which encompasses the diversity of ecosystems [9].

A range of micro-organisms (viruses, bacteria, fungi, protozoa, algae) is also part of biodiversity, some of which can cause diseases in plants and animals. Thus, wild animals and plants in natural environments are repositories of microorganisms that can infect humans, potentially causing new epidemics or pandemics. Therefore, the reduction of impacts generated by deforestation, mining, and cattle raising, among other human activities, is seen as a relevant measure to avoid the risk of emergence of new zoonoses, as such activities put humans in close contact with wild species, with which humans have had rare or non-existent interactions with until recently [10].

Given the importance of preserving biodiversity, the Convention on Biological Diversity (CBD) was signed, at ECO-92, by many countries, including the Brazilian government of that time. This CBD demonstrates the international recognition of the importance of biological diversity, both for the maintenance of the systems necessary for the biosphere's life, in terms of its intrinsic value and its ecological, genetic, social, scientific, educational, cultural, recreational, and aesthetic values. Given this recognition and the realization of the significant reduction in biological diversity caused by human activities, the contract proposes measures for the conservation and sustainable use of resources [11].

On the other hand, the increase in deforestation of the Brazilian Amazonia was accentuated in 2019 and 2020. Indeed, data from the National Institute for Space Research (INPE) show that during the current year of monitoring, which runs from August to July, deforestation increased by at least 28% in 2019 compared with the previous year [12], and by 7% in 2020 [13]. Therefore, there is intense deation during the current government, which is putting into practice actions to loosen environmental inspections and accelerate development in the Amazonia [12]. Furthermore, social media has been a fertile ground for

spreading fake news, which has been used by the president of Brazil, especially concerning the devaluation of national inspections and research institutions, as well as in dissemination that fires in the Amazonia, a rainforest, occur naturally, ignoring research data [14]. Thus, scientists and specialists must stop viewing fake news and conspiracy theories lightly and start seeing them as real problems for the environment [15]. Such fake news may be financially and ideologically motivated and systematically encouraged to promote a given idea, such as causing instability or confusion, which have predominantly focused on three areas: climate and environmental change, vaccines, and pandemics [16].

Indeed, the Amazonia has attracted the world's attention, but the Brazilian Southeast (which is home to the state of São Paulo) is also a region that is enriched with immense biodiversity, and include the regions of Cerrado and the Atlantic Forest. Unfortunately, like the Amazonia, the Brazilian Southeast's original vegetation has been replaced for many years, with pastures and sugar cane cultivation since the beginning of the 16th century and eucalyptus trees from the late 19th century. Even today, the impact continues with agribusiness, which has become one of the most relevant commodities in the Brazilian economy, covering vast areas of the region, intensifying the use of pesticides—contaminating the environment and impacting biodiversity [17].

Such human actions have had a major impact on the diversity of living beings in these biomes. For example, in 2006, only 13.9% of the São Paulo State territory corresponded to the remaining native vegetation [18]. This situation is different for each ecosystem. Currently, the remaining native vegetation of Cerrado is only 3% and it is only 32.6% for the Atlantic Forest [19]. The situation is also worrying both biomes in other Brazilian states. For Cerrado, there was an increase in deforestation by 13% between 2019 and 2020 [20]. For the Atlantic Forest, after an increase in deforestation of 27.2% between 2018 and 2019 [21], there was a decrease of only 9% in the period 2019 and 2020, according to the Atlas of Forest Remnants of the Atlantic Forest [22].

In addition to the great relevance of the economic, political and social dimensions, it is essential to understand that individual actions can also have major impacts on such biomes. An example of this is the recent fire in Juquery Park in Greater São Paulo [23]. The site is a reserve of remnants of Cerrado and an area of springs, covering more than 2 thousand hectares [24]. The fall of a balloon in the region's dry period resulted in the loss of 85% of the park's vegetation cover, seriously impacting local living beings [23].

Among the strategies that can substantially promote the preservation of these biomes, people's education and empowerment are fundamental to transforming attitudes about nature [25–27]. Lasting gains depend on the acceptance of biodiversity and the reasons for its conservation [25]. This concern about biodiversity was already defended at the CBD in 1992. It was established that subscribing nations should provide and maintain educational programs to encourage and promote understanding of the importance of biodiversity conservation and its sustainable use [11]. Educational proposals on biodiversity claim to be important to expand student knowledge about organism diversity, considering that schools can play a crucial role in this learning [28–30].

The perspective of education aimed at this understanding and that attempts to solve environmental issues is not recent; since the 19th century, the theme has been addressed with different focuses, from nature conservation, to the change of individual behaviors, such as combating pollution, to understanding global citizenship and recognizing local identities to face the challenges of sustainability [31].

Nevertheless, discussions on health education and sustainability still make small steps, so formal proposals for integrating health education and sustainability education are still rare [3]. Instead, educational approaches to health and sustainability often address themes of health and food, resulting in the proposal of building and maintaining vegetable gardens in the school environment [32,33].

However, some proposals have gained strength and more prominence within higher education, such as the perspective of "One Health". It recognizes that human health, other animals' health, as well as environmental health are interlinked. Therefore, public health

and educational policies must move towards themes to be worked in an interdisciplinary way [34].

In this study, we discuss whether the integration of biodiversity, sustainability, and health themes are an alternative to raise student awareness and interest in local biodiversity and alert them to the importance of preservation to avoid future pandemics. Research has shown that young Brazilians that are uninterested in local biodiversity can vary between 50% and 67%, depending on the Brazilian region. The Southeast is the region with the highest percentage (67%) of students who are uninterested in local biodiversity, i.e., getting to know about living beings in their locality [35]. Research carried out with students from other states regarding the Atlantic Forest has identified the difficulty for these young people in recognizing which species are exotic and native to their biome [36,37].

Thus, São Paulo State (in the Brazilian Southeast region) has several potential factors that can facilitate future pandemics: a high population density, easy dispersion due to its central position and connectivity with the rest of the country, and increasing deforestation of its biomes. Furthermore, it is located in the Brazilian region where the highest percentage of young people are disinterested in local biodiversity. Moreover, it is located in a country where fake news easily influences people's actions and mindsets, and is fueled by political representatives who collaborate with policies that have intensified deforestation. If, in the scenario of the COVID-19 pandemic, São Paulo gained prominence due to the number of cases and deaths, another similar situation could occur if its biomes and biodiversity are not preserved. Considering that knowledge of local biodiversity is essential for its preservation, but that it is uninteresting to most students, this research sought to understand possible aspects related to biodiversity that can foster interest in young people, especially those from São Paulo State.

Research aiming at verifying the interest of young people in science is based on the assumption that it is necessary to pay more attention to the voices of students in the constitution of curricula and teaching materials. Furthermore, such studies consider that knowing about the interests of young people is important to foster the relevance and attractiveness of scientific teaching [38]. Moreover, considering students' interest in curriculum construction can help to reduce alienation and indifference towards biodiversity conservation and other environmental problems [39]. Thus, it is desirable to consider science contents that are more significant to students, helping them in their education in the context of citizenship [40] and even for their professional choices [41].

Such studies have been carried out in several countries around the world [38,40–47], including Brazil [48–50], seeking to identify young people's interests and attitudes regarding various topics related to science, technology, and the environment [48–50]. Among the subjects investigated in these researches, some items are related to health, diseases, environment, and biodiversity.

To deepen these studies, we sought to understand students' interests in a range of aspects related to biodiversity. Furthermore, to meet local demand, we focused the study on the São Paulo State context to identify and discuss this state's students' interests in biodiversity and how they are related to health issues.

2. Materials and Methods

The work presented here is part of a larger project approved by the Research Ethics Committee of the Federal University of ABC, São Paulo, Brazil (#CAAE:67968217.5.0000.5594).

Data were collected through questionnaires from 9th-grade students (predominantly between 14 and 15 years old) from public schools in the state of São Paulo. A qualitative criterion of maximum variation was applied to delineate the sample [51], which involved choosing a few cases, but cases with extremes of variation, seeking to avoid bias. Therefore, we sought to constitute a heterogeneous sample with different profiles and conditions. Thus, ten schools located in different biomes, with different proximities to the most preserved areas, and with different school performance indicators were chosen.

The state of São Paulo has two biomes, the Cerrado and the Atlantic Forest. Thus, four participating schools were located in cities in the Cerrado biome and four in cities in the Atlantic Forest. These schools were far from the coast, so two other schools on the Atlantic coast were also selected.

In each biome (Cerrado and Atlantic Forest), two schools were selected that were close to the remaining biome area, and two were distant. The close schools were considered to be located within a 20-min walk of these remaining biomes. DataGeo (datageo.ambiente.sp.gov.br, accessed on 30 August 2020) and the Google Maps platform were used to identify possible participating schools meeting these conditions. When there was no clarity about the location of the vegetation characteristic of a biome, we consulted the Municipal Environment Department of the city where the school was located.

In addition to the diversity of contexts mentioned above, among the two schools at each location, it was also decided to choose one with a higher basic education development index (IDEB) and another with a lower IDEB to cover schools with different indexes of development. We sought to consult schools that met these criteria until ten volunteer schools accepted to participate in the study. Thus, the schools in the Cerrado biome were located in the Ribeirão Preto, Ituverava, and São Carlos districts; while in the Atlantic Forest biome the schools were in Santo André, Suzano, Ribeirão Pires, and Novo Horizonte districts; and those on the coast were located in the Caraguatatuba district.

To collect the data, the researchers visited each of the selected school. All school participants were volunteers. They and their parents signed terms of assent and terms of informed consent, agreeing to participate in the research, and their identities were protected. During the visits, the students voluntarily answered the questionnaires. The sample included 83 students from schools close to the characteristic biome, 76 students from distant schools, and 29 students from the coastal schools, adding up to 188 participants.

The questionnaire for data collection was designed and validated by the research group and approved by the Research Ethics Committee of the Federal University of ABC, São Paulo, Brazil. It was based on the questionnaires used in the ROSE Project surveys [38,49]. However, the ROSE Project was broader, aimed at understanding the interest of young people in science and technology, and contained few issues with a focus on biodiversity. Thus, we used the items on biodiversity, environment, evolution, and knowledge production process present in the ROSE Project, but we also included a series of other items, specifically on biodiversity, for this research. Furthermore, we also based on Tracana et al.'s [52] work to elaborate some items related to student interest in matters associated with the feelings of living beings.

Students were asked to answer 73 items of the questionnaire using a four-point Likert-type scale, where 1 means "not interested"; 2 "little interested"; 3 "very interested"; and 4 "extremely interested". Although the typical Likert scale [53] has five points with a neutral option in the middle, in practice, the meaning of such a central option may vary among respondents, and it may be chosen due to a lack of knowledge or motivation to answer the questions. For this reason, we opted for questions on a four-point Likert-type scale, removing the central (neutral) point. In addition, a specific item for the "I don't know" option was not added with the intention that students would choose only one of the four scale points without being confused by the neutral point [54]. Thus, students were instructed to leave a question blank if they did not know how to answer it or understand it [49,54].

The analyzed items were grouped in nine categories of issues related to biodiversity, namely: "curiosities about living beings", "health or human utility", "danger", "fear and disgust", "diversity of organisms", "ecology", "impacts and preservation of organisms", "evolution" and "development of science". This work aimed to compare the category "health or human utility" (which included items that relate biodiversity to human utility and health) with the category "diversity of organisms" (which included items related exclusively to biodiversity, without a specific contextualization element). To see the items in each category, please see Table S1 in the Supplementary Materials.

The answers were tabulated using a Microsoft Excel spreadsheet, transferred to the statistical software R, and submitted for descriptive and inferential statistical analyses. Descriptive analysis provided the means (x) and standard deviation (SD) of the responses for each item or category. The Shapiro–Wilk normality test [55] was initially used to determine what data dimension scores had a normal distribution to a statistical significance of 5%, and concluded that most dimensions had no normal distribution. For this reason, a non-parametric test was chosen to analyze the data in this study [55]; the paired Wilcoxon test with Bonferroni correction. The test was used to calculate the differences between pairs of item means, and between the categories means. Bonferroni's correction was adopted because it allows the interpretation of all p-values in a table together, allowing to consider the concurrent validity of all objective data with a significance of 5% at most.

The Wilcoxon test, but without Bonferroni correction, was also used to determine differences between boys and girls. The Wilcoxon test was also used to identify differences between schools that were close and far away from the biome areas. The Kruskal–Wallis test was used to study the association between the school contexts (close to the Atlantic Forest, far from the Atlantic Forest, close to Cerrado, far from Cerrado, and on the coast) and the mean scores of the "biodiversity" and "health or human utility".

Subsequently, health items were analyzed. For this, the category "health or human utility" was divided into three new subcategories: "biodiversity and health utility", "biodiversity and diseases" and "biodiversity and other human utilities". The same statistical procedures were applied to compare these three subcategories in pairs. To see the items in each category, see Table S2 of the Supplementary Materials.

3. Results

Results showed that students' interests on biodiversity were mainly linked to the categories "development of science" (x = 2.84, SD = 0.60), "evolution" (x = 2.79, SD = 0.61), "impacts and preservation of organisms" (x = 2.79, SD = 0.63), "health or human utility" (x = 2.74, SD = 0.56), and "danger" (x = 2.72, SD = 0.64) (Figure 1). For descriptive statistics of each category, see Supplementary Table S3 of the Supplementary Materials.

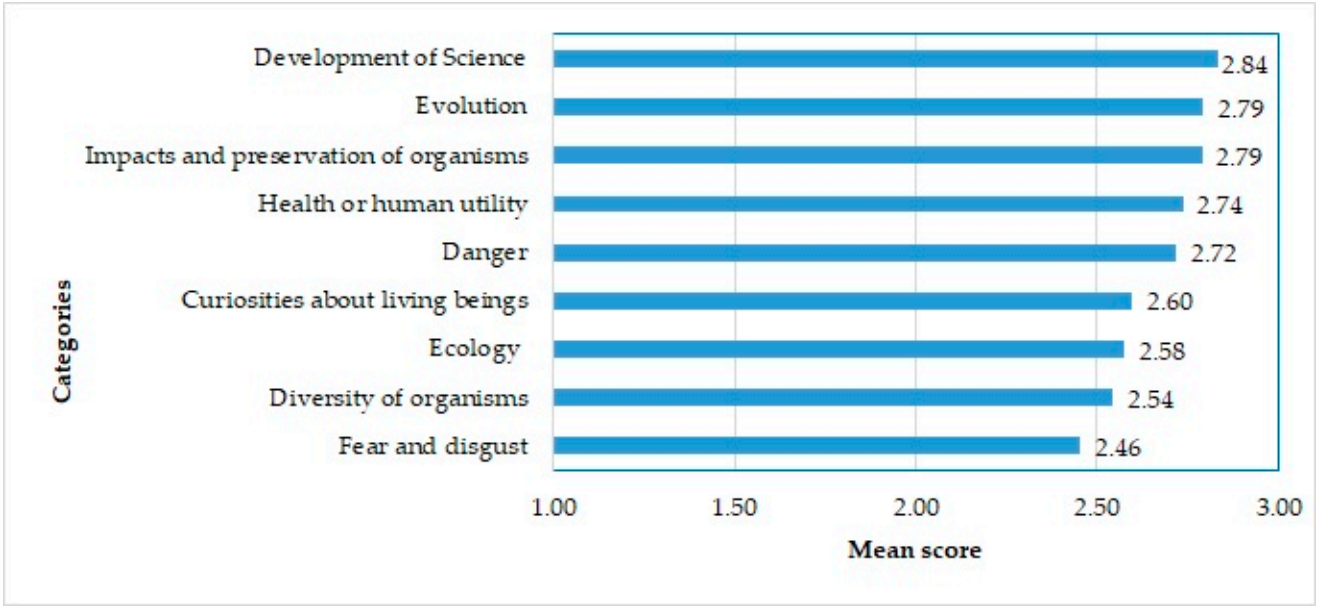

Figure 1. Mean scores of the nine categories.

This study focuses on the students' interests in biodiversity and how they are related to health issues. Significant differences ($p = 0.04$) were found between the "health or human utility" category and "Diversity of organisms" (x = 2.54, SD = 0.60). Therefore, these results

showed that students are more interested in organisms when they are linked to "health or human utility" than in knowing about the diversity of living organisms.

No statistically significant differences were found between boys and girls, either in the category "health or human utility" ($p > 0.1$) or in the category "diversity of organisms" ($p > 0.5$).

No significant differences were found between the "health or human utility" items mean scores in the different contexts (close to the Atlantic Forest, far from the Atlantic Forest, close to Cerrado, far from Cerrado, and on the coast) ($p = 0.397$, mean score minimum of x = 2.63 and maximum of x = 2.89). Similarly, no significant differences were found between the proximity of the schools (close to and far from the biomes) ($p = 0.079$, mean score 2.83 for distant and 2.68 for close).

Within the category "health or human utility", most items had a mean score greater than 2.5 (Figure 2), showing that students were interested in most of these subjects. In particular, they were interested in: "a56—Use of medicinal herbs or health treatments with alternative medicine (acupuncture, homoeopathy)"; "c3—Use of medicinal plants in pharmacy companies"; "a39—Use of plants in the pharmaceutical industry"; "a38—Bacteria and the manufacture of medicines", all with averages above 2.82. To verify the descriptive statistics of the categories of "health or human utility" and "diversity of organisms", see Supplementary Tables S4 and S5, respectively, in the Supplementary Materials.

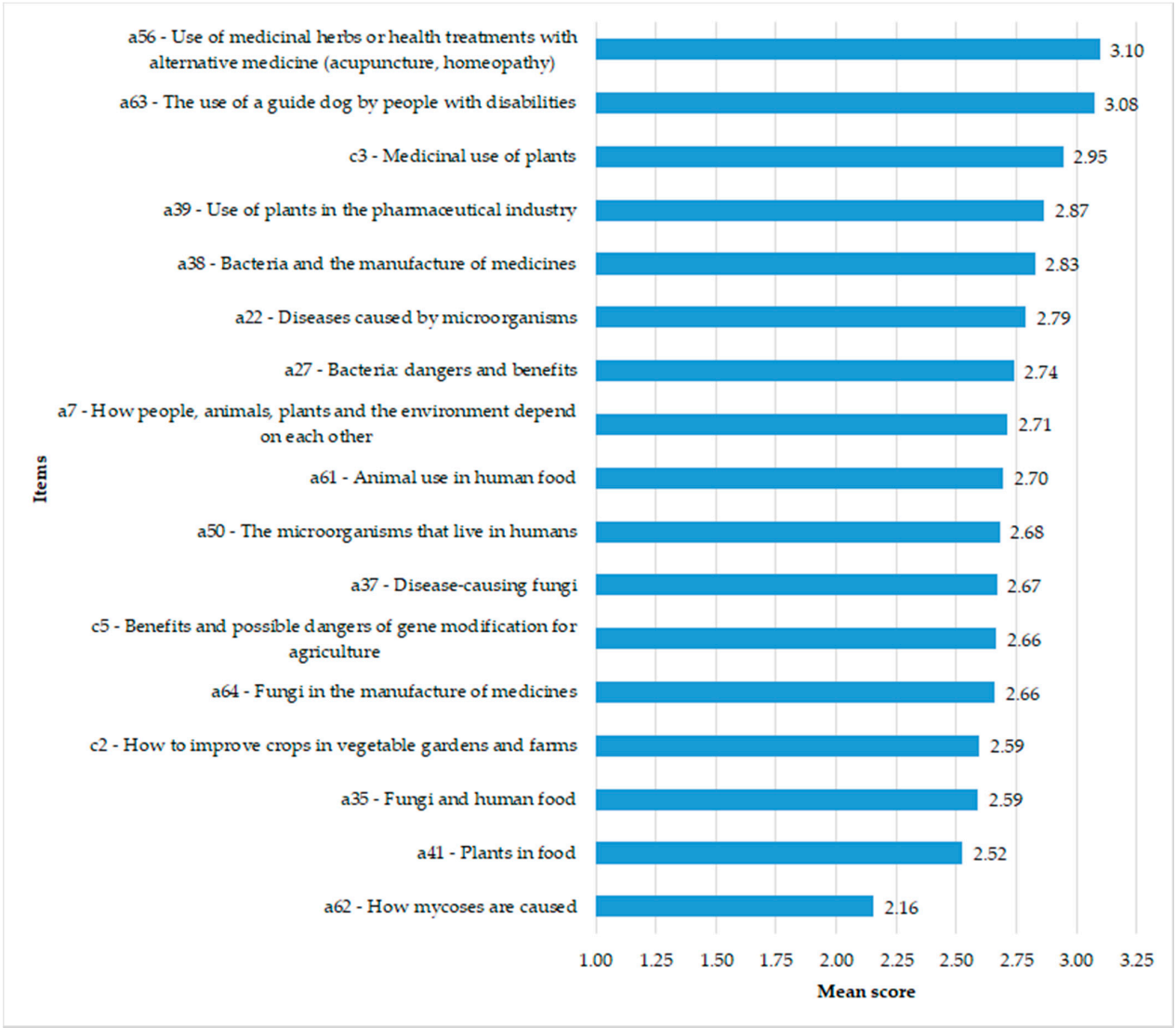

Figure 2. Mean scores of the "health or human utility" category items.

Having this large number of high scores for "health or human utility" items, this category was divided into three subcategories: "biodiversity and health utility", "biodiversity and other human utilities", and "biodiversity and diseases". Results in Figure 3 show that the items in the subcategory "biodiversity and health utility" together had the highest mean score (x = 2.89, SD = 0.72), revealing students' great interest in the subject. The differences between this subcategory and either "biodiversity and other human utilities" (x = 2.74, SD = 0.55) or "biodiversity and diseases" (x = 2.6, SD = 0.75) are statistically significant, with (p = 0.04) and (p < 0.01), respectively.

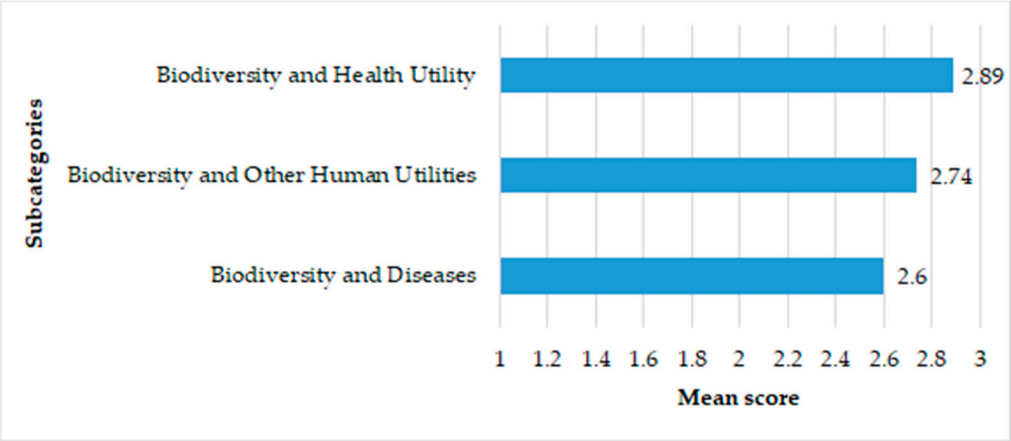

Figure 3. Mean scores of the three "health or human utility" subcategories.

However, the difference between the subcategories of "biodiversity and other human utilities" and "biodiversity and diseases" were not significant (p = 0.28). These results show that students are more interested in biodiversity when it is linked to utility for human health than to other forms of utility for humans or diseases. To see the descriptive statistics of the three "health or human utility" subcategories, see Supplementary Table S6 in the Supplementary Materials.

In addition, many disease-related items in the category "health or human utility" had high scores (see Figure 2): "a22—Diseases caused by microorganisms" (x = 2.78, SD = 0.95), "a27—Bacteria: dangers and benefits" (x = 2.73, SD = 0.99) and "a37—Disease-causing fungi" (x = 2.66, SD = 1.03). There were no statistically significant differences when comparing each of these items with each of the three prominent items on health utility: "a56—Use of medicinal herbs or health treatments with alternative medicine (acupuncture, homoeopathy)", "c3—Medicinal use of plants", "a39—Use of plants in the pharmaceutical industry", "a38—Bacteria and the manufacture of medicines" (all p > 0.3). These data showed that students are interested, not only in the utility of organisms for humans, but also in disease-related issues.

Within the category "health or human utility", significant differences were only identified for two items, with girls having higher scores: "a63—The use of a guide dog by people with disabilities" (girls: x = 3.24, SD = 0.93; boys: x = 2.85, SD = 1.04; p = 0.01) and "a62—How mycoses are caused" (girls: x = 2.28, SD = 0.80; boys: x = 2.01, SD = 1.02; p = 0.04).

Students were also interested in the category "impacts and preservation of organisms" (x = 2.79, SD = 0.63), with a score that was slightly higher than the category "health or human utility" (x = 2.74, SD = 0.56) (see Figure 1), although the difference between the means was not statistically significant (p = 1.0).

The mean score of the category "diversity of organisms" (x = 2.54, SD = 0.60) was smaller than that of "health or human utility" (x = 2.74, SD = 0.56) or "impacts and preservation of organisms" (x = 2.79, SD = 0.63) (see Figure 1). The item "a18—Differences and diversity of flowers, leaves and fruits" has the highest mean score (x = 2.62, SD = 0.94)

of the other plant items of the "diversity of organisms" category (Figure 4); however, this a18 item was significantly lower ($p = 0.004$) than item "a56—Use of medicinal herbs or health treatments with alternative medicine (acupuncture, homoeopathy)" (x = 3.10, SD = 0.98) of the "health or human utility" category (Figure 2). Indeed, item a18 was also lower than items "c3—Use of medicinal plants in pharmacy companies" and "a39—Use of plants in the pharmaceutical industry" of the "health or human utility" category (Figure 2), although no statistically significant differences were found ($p > 0.05$). These results again show that students seem to be more interested in plants when they are associated with their health utility.

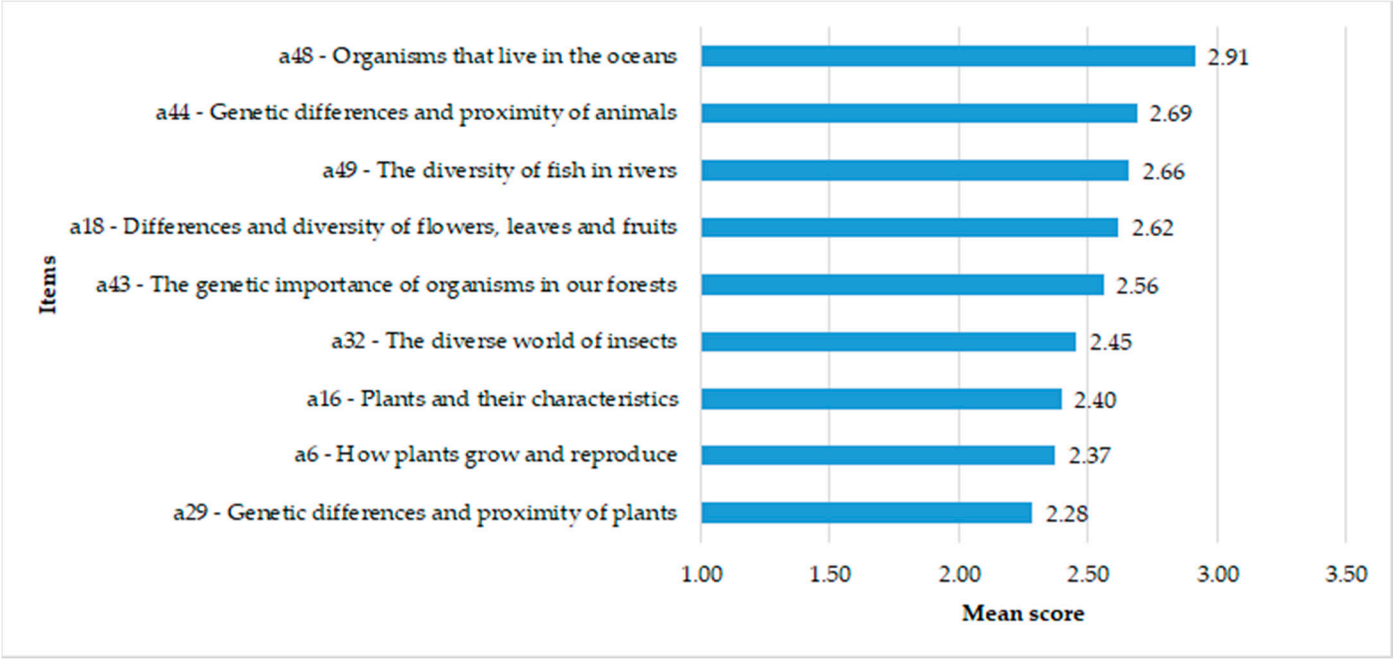

Figure 4. Mean scores of the "diversity of organisms" category items.

In the items of the "diversity of organisms" category, no significant differences were identified between girls and boys.

4. Discussion

Our results indicated that the participating students were more interested in themes related to biodiversity when they are contextualized and associated with the use of organisms for human health, than in themes intrinsically related to biodiversity and the study of the organisms themselves. In contrast, and using the same Likert-type scale for a diversity of items related to the interest of young Brazilians in topics related to science and technology, Santos-Gouw [49] found no statistically significant difference between contextualized items and items only intrinsically related to scientific content.

However, student interest in health-related topics identified in our study may be related to their great interest in human biology, as previously identified in studies in Brazil [48–50]. For example, Santos-Gouw [49] found high mean scores for items such as: "how the human body is made and how it works" (x = 3.03) and "health care" (x, =; 283). Furthermore, these surveys also identified mean scores that signal the interest of young people in topics related to the category "health, fitness and beauty" in samples of students from Tangará da Serra (Mato Grosso State) (x = 2.78) and São Caetano do Sul (São Paulo State) (x = 2.95) [48], and in a national sample (x = 2.86) [49].

This interest in human biology and health has also been identified in research in other countries, such as the United Kingdom [56], using focus groups to understand interests in the science curriculum. Young participants were interested in understanding habits to

keep their bodies healthy and to cure illnesses. These issues foster self-esteem when they feel at ease to explain phenomena in their daily lives and give informed advice to their families and colleagues [56].

Studies carried out by the ROSE Project, or based on it, in different countries, have also shown that young people are interested in topics related to the human body and health, as well as in diseases, in Sweden [40], Finland [57], Slovakia [58], and Italy [43]. Similarly, some surveys not only identified young people's interest in the human body and health, but also found that they are the most popular themes in Brazil [49,50], England [56], Sweden [40], Ireland [44], Finland [57], and Italy [43].

Although the present research did not focus on a gender analysis on the human body and health, it is important to note that many studies in the literature indicate that these themes are those most of interest to girls [40,43,45–50,57]. Our results showed two health-related items that had gender statistically significant differences ($p < 0.05$), with girls having more interest than boys in both items: "a63—The use of a guide dog by people with disabilities" and "a62—How mycoses are caused" of the "health or human utility" category. Furthermore, no gender statistically significant differences were found in the "diversity of organisms" category.

The item "a56—Use of medicinal herbs or health treatments with alternative medicine (acupuncture, homoeopathy)" of the "health or human utility" category was the most selected question (x = 3.10, SD = 0.98—see Figure 2) by the inquired students, suggesting that they are interested in medicinal herbs and alternative medicine. In addition, similar studies in Brazil [49,50] have shown that students were more interested in medicinal plants than alternative medicines (acupuncture, homoeopathy). Together, these results indicate that students see plants as very relevant to human health, more so than acupuncture or homoeopathy.

Furthermore, the present study clearly showed that the "health or human utility" category was more interesting to students than the "diversity of organisms" category (see Figure 1), which was emphasized when comparing the items in Figure 2 ("health or human utility" items) and Figure 4 ("diversity of organisms" items). Indeed, the present study supports earlier Brazilian and international studies demonstrating that students are more interested in learning about the use of plants for human health than plants or animals [40,43,49,50,57,58].

Moreover, no significant differences were found between the specific biomes (Atlantic Forest, Cerrado, and the coast), nor between the school distance to the biome areas (close to or far from). Furthermore, the school curricula of the state of São Paulo [59,60] do not help to understand student interest in the medicinal use of plants, as it is not included in the contents. Although another survey conducted in Northeastern Brazil [61] found a statistically significant difference between the knowledge of medicinal plants of students in rural and urban schools ($p = 0.001$); in the present research it was important to consider that schools close to the biome areas were not always located in rural regions. All schools were located in urbanized neighborhoods, although some were located in cities in the interior region of São Paulo State in a large rural area.

The great interest in medicinal plants is not specific to the present context [62]. The use of medicinal plants has been found in text records since antiquity, and today it can be found in students' families [63]. Indeed, research carried out in the context of the state of São Paulo evidenced the influence of family tradition on the knowledge and use of medicinal plants [64,65]. Furthermore, studies have shown that more than 100 plants are commonly known and used for this purpose in the region [66–69]. Possibly, familiar knowledge can influence students' interests in plants. Therefore, research dedicated to studying this interaction is of great relevance.

As for other topics on biodiversity and its relationship with health, the curricula predominantly cover the subject of microorganisms as a cause of disease [59,60]. They also discuss, but with less emphasis, (1) the use of microorganisms in the production of medicines, fuels, and food, and (2) the advantages and disadvantages of organic and

conventional agriculture associated with health and environmental preservation. However, it is not possible to say with certainty that there is a direct relationship between these topics and students' interest in the items analyzed in this study. Therefore, future research needs to address this to better understand the influence of these topics in the curricula in terms of young people' s interests.

In addition, this study showed that items related to diseases caused by microorganisms are also of students' interest (see Figure 3), being that mycoses the less attractive item to students (see Figure 2). This disinterest may be related to a feeling of fear and repulsion or having little knowledge about fungal diseases. In fact, the knowledge of the diversity of fungi and their beneficial and adverse effects are still very limited and poorly presented in basic education curricula [70–74]. Since many students have some aversion to the topic, it is relevant to promote pedagogical actions that positively present the diversity of fungi, highlighting their role in terms of ecological and sanitary aspects [73–75]. Thus, improving learning of microbiology favors understanding the role of these species in the maintenance of ecosystems and in human health. It further allows students to take into account other aspects of the diversity of living beings, in addition to immediate conceptions, which attribute positive and negative values to certain organisms, favoring an understanding of their importance [70,71,75–77].

The human and nature relation can be seen in anthropocentric (nature utilization) or ecocentric (nature preservation) perspectives, with the pole of "utilization" being opposed to "preservation" [52,78]. The present study suggests that students expressed an anthropocentric view of nature as they showed more interest in "health or human utility" than in "diversity of organisms", emphasizing the human utility view of nature to the detriment of the biocentric view.

Although 50% to 67% of students were not interested in their local biodiversity [35], the present study also showed that some students are interested in the "impacts and preservation of organisms". This interest in preservation agrees with earlier studies showing that young Brazilians strongly agree with the need for individual and collective actions to conserve the environment [35,48–50]. In fact, a previous study [35] showed that the Brazilian Southeast, where São Paulo students are located, is the region with the most uninterested young people in the context of biodiversity (67%). Furthermore, other studies reveal that students do not refer to human relationships with nature often [36] and when asked the names of Brazilian plants, students listed 17 native species and 12 exotic ones [37].

This study reinforces the idea that learning about biodiversity is important to promote in schools to influence students' concerns regarding the preservation biodiversity, allowing individual actions to reduce impacts, such as conscious and sustainable consumption [25,79,80]. Furthermore, relative to other research in the literature, the present data show that a way to encourage this interest among young people is by connecting biodiversity themes with health.

This approach is even more relevant when considering that biodiversity conservation is essential to avoid new pandemics and other risks to human health [2]. Indeed, reducing environmental impacts, such as deforestation, cattle raising, and mining, among others, is essential to mitigate impacts on ecosystems that provide contact between wild species with humans, facilitating the migration of pathogenic microorganisms to humans, causing diseases [10]. Thus, the educational work on biodiversity from the perspective of "comprehensive health" (One Health) [34] can be a way to engage students, being a starting point to increase their interest in local biodiversity.

Finally, it must be mentioned that the preservation of biodiversity can be determined not only by its instrumental value but also by its intrinsic value, related to the inherent value of each species itself [81]. The instrumental value of health is only a way to promote the value of intrinsic biodiversity. Education focused on planetary sustainability should promote the view that taking care of nature and ensuring the survival of all species of plants, animals and microorganisms, and of ecosystems is fundamental to guaranteeing human existence [3,31], the responsibility of which must be assumed by different social actors,

individually and collectively [82]. Learning activities can be supported by interdisciplinary approaches that value cultural heterogeneity, such as ways of conserving the nature of native people and the production of sustainable agriculture [31]. Not all knowledge to be taught thrives in school [83]; however, as already mentioned, it is important to consider the motivations of young people to encourage their interest in what is taught [38]. Thus, starting from the relationship between biodiversity, its sustainable use, and human health, it can be possible to increase students' interest in their local biodiversity.

5. Conclusions

This study showed that the participating students from the state of São Paulo are more interested in biodiversity themes when connected to health than when it is discussed without any contextualization. Within the biodiversity theme, the health utility of living beings, especially for medical purposes, is a relevant aspect that drew students' attentions. Therefore, education proposals involving the teaching of biodiversity linked to health and sustainability issues may greatly interest young people, particularly considering the importance of preserving biodiversity to avoid new pandemics.

Furthermore, given the context of environmental and health emergencies that modern society has been experiencing with the COVID-19 pandemic and the growing wave of scientific denial with the spread of fake news, it is increasingly necessary that teaching biodiversity consider students' interests. Learning scientific content close to students' interests and reality helps them to understand the preservation of ecosystems so that they can make informed decisions regarding the preservation of species and decisions that affect individual and collective health. In addition, this teaching approach should also reflect on new possibilities for occupations regarding the environment that are more sustainable and promote socio-environmental justice, fundamental aspects in the promotion and guaranteeing of human health.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su132413767/s1, Table S1: Items by category of biodiversity interests, Table S2: Items by subcategory of the "health or human utility" category, Table S3: Marginal descriptive statistics of students' interests in biodiversity by category, Table S4: Marginal descriptive statistics of "health or human utility" category items, Table S5: Marginal descriptive statistics of "diversity of organisms" category items, Table S6: Marginal descriptive statistics of "health or human utility" subcategories.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due the necessity due to the necessity of wait the complete publication of all articles related to the database.

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