



RELATIONSHIPS BETWEEN CONCEPTIONS OF BIODIVERSITY AND SINGULARITIES OF BIOLOGY STUDENTS AND PROFESSIONALS

ARTICLE

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ABSTRACT:

This work aims to investigate possible associations between conceptions of biological diversity and singularities of Brazilian biology undergraduates and professionals through the administration of a questionnaire composed of Likert items. This instrument was applied remotely and obtained 112 responses. A high level of agreement with biocentric perceptions of biological diversity was identified; on the other hand, there was a rejection of anthropocentric elements. We also noticed a lack of discussions related to the integration of the human species as part of nature and biodiversity. Respondents were also empathetic to the situations experienced by ethnic/racial groups, LGBTQIA+, people with disabilities and socioeconomically vulnerable people. From the correlation between the proposed themes, we noticed that subjects more sensitive to class diversity and socioeconomic inequality tended to be more biocentric, suggesting the possibility of a relationship between sociocultural and biological diversity for the recognition, appreciation and respect for the interspecific alterities.

Keywords:

Biocentrism;
Interspecific alterations;
Teacher training.

RELACIONES ENTRE CONCEPCIONES DE BIODIVERSIDAD Y SINGULARIDADES DE ESTUDIANTES Y PROFESIONALES EN BIOLOGÍA

RESUMEN:

El objetivo de este trabajo es investigar posibles asociaciones entre concepciones de diversidad biológica y singularidades de estudiantes de grado y profesionales en biología brasileños, a través de la aplicación de un cuestionario compuesto por ítems tipo Likert. Este instrumento se aplicó de forma remota y obtuvo 112 respuestas. Se identificó un alto nivel de acuerdo con las percepciones biocéntricas de la diversidad biológica; por otro lado, se observó el rechazo a los elementos antropocéntricos. También notamos una falta de discusiones relacionadas con la integración de la especie humana como parte de la naturaleza y la biodiversidad. Los encuestados también se mostraron empáticos con las situaciones que viven los grupos étnicos/raciales, LGBTQIA+, personas con discapacidad y personas socioeconómicamente vulnerables. A partir de la correlación entre los temas propuestos, percibimos que los sujetos más sensibles a la diversidad de clase y la desigualdad socioeconómica tendieron a ser más biocéntricos, sugiriendo la posibilidad de una relación entre la diversidad sociocultural y biológica para el reconocimiento, valoración y respeto de las alteridades interespecíficas.

Palabras clave:

Biocentrismo;
Alteridades
interespecíficas;
Formación de profesores.

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RELAÇÕES ENTRE CONCEPÇÕES DE BIODIVERSIDADE E SINGULARIDADES DE LICENCIANDOS E PROFISSIONAIS DE BIOLOGIA

RESUMO:

Objetivamos com este trabalho investigar possíveis associações entre concepções de diversidade biológica e singularidades de licenciandos e profissionais de Biologia brasileiros através da aplicação de um questionário composto por itens *Likert*. Esse instrumento foi aplicado de modo remoto e obteve 112 respostas. Foi identificado alto índice de concordância com percepções biocêntricas de diversidade biológica; em contrapartida, percebeu-se rejeição de elementos antropocêntricos. Notamos ainda carência nas discussões relacionadas à integração da espécie humana como parte da natureza e da biodiversidade. Os respondentes se mostraram, também, empáticos com as situações vividas por grupos étnico/raciais, LGBTQIA+, pessoas com deficiência e pessoas socioeconomicamente vulneráveis. A partir da correlação entre as temáticas propostas, percebemos que sujeitos mais sensíveis com a diversidade de classes e a desigualdade socioeconômica tenderam a ser mais biocêntricos, sugerindo a possibilidade de relação entre a diversidade sociocultural e biológica para o reconhecimento, a valorização e o respeito às alteridades interespecíficas.

Palavras-chave:

Biocentrismo;
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INTRODUCTION

Because of the need to effectively cope with current environmental crisis, we emphasize the importance of the role of education in training critical and active individuals to be able to assume a position and build solutions to environmental problems, considering the wellbeing of all species and the planet. To achieve this, we rely on the topic of biodiversity, which can bring up discussions based not only on biological and ecological perspectives, but which also include approaches that encompass social, cultural, economic, political issues, among others.

In this regard, according to Ingold (1995), who stands up to advocate the respect to existing diversities among living species in the world, and Pagan (2009, 2018, 2020), who supports the theory of a relationship between biodiversity and singularities, we aim in this study to investigate possible associations between conceptions of biological diversity and singularities of Brazilian biology undergraduates and professionals.

The academic training of biology teachers is a privileged space because biological diversity is one of the core themes of this specific course, and didactic subjects, for example, can allow an approach to issues related to the sociocultural characteristics of students as well as their own experiences. However, what we usually see in the academy is a debate limited to subjects that tend to separate environmental activities from social activism, even disregarding the personal and collective experiences that students have with nature (Kawasaki & Oliveira, 2003).

We therefore propose an activism for diversities by integrating discussions between biological diversity and sociocultural diversity. The purpose is to determine whether in the training of biology teachers, which obviously aims to build meanings and insights about nature and living beings, there is a possibility of reflecting our own humanity, individually and collectively, as a way to encourage discussions aiming to deconstruct anthropocentric and disintegrating processes.

THEORETICAL FRAMEWORK

Biodiversity comprises “[...] the variability of living beings of all origins [...] and the ecological complexes of which they are part; also comprising diversity within species, between species and ecosystems” (MMA, 2000, p. 9). The three levels cited in this definition – diversity of species, between species and ecosystems – are interconnected, based on which biological and ecological discussions on identification, quantification, preservation and conservation are built (Léveque, 1999). These mechanisms are largely disseminated in universities, which mostly teach about the specific, genetic and ecosystem components of the variability of living beings.

However, we understand that the human species is part of such diversity, including all their sociocultural aspects, which are not possible to separate. Authors such as Rédua & Kato (2017) propose that discussions about biodiversity should not be limited to the scientific aspect of its concepts, but should overcome the dichotomy between humans and nature and their attempts to control other living beings.

In addition, authors have noticed, in the perceptions of undergraduates, a variety of concepts and representations related to biodiversity that go beyond this purely biological viewpoint, by including personal and community experiences, many of them more respectful and less aggressive to the environment (Kawasaki, & Oliveira, 2003; Faustino, Roberto, & Silva, 2017; Kato, 2020; Pagan *et al.*, 2021).

Individual and sociocultural conceptions, particularly those that do not serve capitalist expectations, are relegated to a secondary position in the educational process, stimulating a less significant learning. Regarding biodiversity issues, more specifically, sustainable, effective actions would be impaired as well as the reformulation of fair relationships with other species.

The Brazilian academic training allows for the configuration of a wide range of social aspects that comprise cultural diversity, a diversity that is dynamic and constituted of individual (internal) and collective (external) elements (Oliveira, 2008; Cardoso, 2014). The identification and study of these elements can be perceived in diverse ways, including from singularities and alterities, having biographic traits as indicators, as used in the study of Santana (2017).

We understand singularities as behaviors and personal and/or collective orientations that make us unique; they are social, cultural and subjective elements that transform and are transformed by the environment in which we live (Santana, 2017). Alterities are based on the premise of recognizing and respecting others’ singularities, and are defined by Furtado (2016, p. 1) as the ability “[...] to put oneself in someone’s shoes in interpersonal relationships, with thoughtfulness, appreciation, identification and dialogue”.

Although few studies seek to correlate the conceptions of biodiversity and singularities, we intend to do it here, considering that biological diversity conceptions are built, especially upon what we have learnt and experienced individually and collectively. So, based on the responses given by biology undergraduates and professionals, we intend to classify conceptions of biological diversity into anthropocentric and biocentric ones, identify singularities and recognize alterities, and, finally correlate both scientific fields.

Such association between singularities and alterities, which fosters the understanding of who I am and who the other is, can stimulate insights and discussions about more diplomatic relationships not only with our own species but with other species in the world, opening ways for a balanced coexistence (Furtado, 2016; Pagan, 2021).

METHODOLOGY

To meet the proposed goals, we decided to use a questionnaire as the main instrument for data collection. The instrument was validated using the Delphi method, which consists of reading and assessing qualitatively the instrument by specialists in the area (Marques, & Freitas, 2018).

We aimed to identify conceptions of biological diversity grouped into four categories built *a priori* based on the literature of the subject: anthropocentric, biocentric, integrating and disintegrating conceptions. As the Santos *et al* (2021) characterize, the anthropocentric category includes conceptions that evoke the superiority of humans over other living beings. In turn, biocentrism establishes that all living beings on this planet have equal rights of survival (Levai, 2011).

The integrating perceptions of biodiversity were grouped considering human beings and their social, political, economic, cultural and artistic aspects as an integral part of nature and biological processes that are inherent to the variability of human beings (Santos *et al*, 2021). In contrast, disintegrating perceptions of biodiversity express essentially scientific concepts, using ecological and biological terms and generalist, romantic definitions, separating man from nature (Santos *et al* 2021).

To recognize the respondents' sensitivity and prejudice among Brazilian minoritarian groups, we organize questions about these singularities into the following categories: Inclusion/Exclusion: ethnic/racial; persons with disabilities and LGBTQIA+; women workload (third shift); diversity of beliefs; socioeconomic aspects.

About the ethical responsibility of research with human beings, this study was submitted to the Research Ethic Committee Involving Human Beings (CEP), of Federal University of Sergipe. The questionnaire was administered to Biology students and professionals from Brazilian universities, aged 18 years and over, who agreed to participate by signing the Informed Consent term. These students were approached with the help of university professors who disclosed the information throughout Brazilian regions. Therefore, we collected responses from diverse socio-regional aspects, which allowed a broader scope of study and ensured richness of results, although it is important to mention that the small number of respondents, because of the difficulty in collecting data during the Covid-19 pandemic, does not represent a sample that can be considered national, which however does not invalidate the interpretation of trends.

In the questions about biodiversity and singularities, the Likert scale was used, i.e., for each category proposed, affirmative statements were built where respondents should express their agreement, indifference or disagreement (Cunha, 2007). The following rating scales were used: totally agree, agree, neither agree nor disagree, disagree and totally disagree. In this configuration, databanks were built as follows: the lower the mean score obtained in the question, the greater the respondents' agreement with the statement.

The answers were tabulated and inserted in the Statistical Package for the Social Sciences (SPSS). Based on the reports produced by this analysis, it was possible to interpret the answers through theorizations based on the consulted references.

In addition, the responses of each category were tested for reliability using Cronbach's Alpha. This testing enabled to estimate how consistent were the statements within the proposed categories (Maroco, & Garcia-Marques, 2006). The Cronbach's Alpha is considered acceptable if its value is higher than 0.6.

For better internal consistency of the proposed categories, during data analysis, some statements that generated discrepant responses were excluded. The final statements of each group constitute the latent variables, which, according to Pagan (2009, p. 35), "arise from the sum of answers given about a series of sentences."

The latent variables could be analyzed in categories and tested. In this case, the Spearman's coefficient test was used, which examines the likelihood and degree of association between variables (Guimarães, 2003).

RESULTS AND DISCUSSIONS

In this section we will describe the characteristics of the participants and present an analysis of collected data, observing their relation with the categories defined in the study.

A) CHARACTERISTICS OF THE PARTICIPANTS

A total of 112 responses were obtained using the questionnaire. Of this total, the majority, 53.5%, are participants from the Southeast region, specifically the states of Minas Gerais, São Paulo and Rio de Janeiro. Following are representatives from the Northeast region (Sergipe, Ceará, Bahia and Maranhão) with 38.4%; North region (Amazonas) and Midwest (Mato Grosso do Sul and Mato Grosso) with 3.6% each. And, finally, the South region (Rio Grande do Sul), representing 0.9% of the participants.

Such distribution of participants was possible because the questionnaire was administered via the internet. Also, the contribution of teachers from public universities in these regions helped divulge the project. So, we succeeded in obtaining representation of diverse Brazilian states, which have specific relationships with nature according to their sociocultural realities.

With respect to housing, 4.6% of the participants live in the urban area and 5.4% in the rural area. According to the IBGE Census (2010), 84% of Brazilians live in the urban area, and 14% in the countryside. Such urbanization results from the industrialization and mechanization processes in agriculture, among other factors, which reduced family labor (Silva, 2018). To us, this is a very important aspect, considering that more respectful positions towards nature and, consequently, with living beings, can be favored by closer relations with the natural environment.

Regarding age, 72.6% of the participants were 18 to 29 years old; 24.1%, 30 to 50 years; and 3.6% were aged 51 years or over. One relevant aspect about this characteristic, which shows that the majority of respondents were young, can be configured by the fact that this public is among the rising environmental activists (*Thirty...*, 2019), and, therefore, can be more engaged in less aggressive environmental actions and in seeking innovative solutions for the current environmental crisis and biological diversity.

With respect to gender, 59.9% of participants were female, 36.7%, were male, and 3.4% reported being genderfluid, which is related to gender fluidity, i.e., gender that can be changed over time; therefore, there may be an identity expression that lies between female and male, binarism and agender (*Redação...*, 2017). The presence of a majority of female conceptions in this study may represent the relationships that they have with nature, especially because in recent years it has been emphasized their importance in promoting environmental preservation, sustainable consumption and fighting against wastes (Jacobi, Empinotti, & Toledo, 2015).

With respect to education, 74.1% of respondents were undergraduates: 92.1% were studying for being future teachers of biological sciences and 7.9% were pedagogy students. We decided to consider the answers of pedagogy students in the analysis because they have been trained to become licensed teachers in Early Childhood Education, where they have the opportunity to present environmental themes in a playful manner, or they can work in school management, coordination and other education-related activities.

About the training period, 68.7% of these undergraduates had already completed half of the course (5th term). We infer from this information that there is a possibility of finding more mature positions, resulting from the training contributions of these students.

Of the 25.9% of the graduated participants, 71.7% had a graduation degree, 9.7% were specialists, 9.7% had a MS degree and 8.8% a PhD degree. They are professionals in the area of biological sciences and teachers of science and biology. We could then perceive the conceptions that biology students and professionals have about biological diversity and singularities, favoring the correlation between these two points within the training and teaching scopes.

B) CONCEPTIONS OF BIODIVERSITY

Of the four proposed sections of biological diversity, namely, anthropocentric, biocentric, integrating and disintegrating, the integrating conception did not achieve the minimum level of reliability (Cronbach's Alpha > 0.6); therefore, it could not be assessed as a category.

By observing the overall means of the three validated categories of biodiversity, we noticed the following sequence: 4.02 for the anthropocentric category; 3.34 for disintegrating and 1.59 for biocentric. These means tell us that the respondents tended in general to disagree with the anthropocentric statements; contrarily, they agreed with the biocentric approaches. The respondents also tended not to express a position for statements of the disintegrating section.

Anthropocentric and biocentric categories

The anthropocentric category achieved a Cronbach's Alpha of 0.628 (Chart 1). Statements B4, B10, B13 and B18 had more than 80% of disagreement.

Chart 1. Distribution of frequencies about biodiversity expressed in percentage: anthropocentric category

	Item	Totally agree	Agree	Do not agree nor disagree	Disagree	Totally disagree
B4	The environmental issue is less important than social problems such as hunger and poverty	1.0	2.8	10.8	35.6	49.8
B10	Humans should control nature because they are more intelligent than other living beings.	1.8	4.5	16.1	21.4	56.2
B13	No community can live in harmony with nature.	1.8	3.6	9.8	43.7	41.1
B17	There is no problem in man exploiting nature.	2.7	17.0	20.5	28.6	31.2
B18	Nature is an asset that belongs to humans.	2.7	1.8	12.5	33.9	49.1
B19	Humans cannot live without causing damages to nature.	3.6	17.9	22.3	44.6	11.6
Cronbach's Alpha: 0.628; Tukey's test: < 0.001; Average overall rating: 4.02.						

Source: Authors.

According to items B10 e B18, it can be seen that the majority of respondents do not perceive nature as an asset, resource or value belonging to mankind; even with the "intelligence" attribute, it can be perceived that all natural elements, live or not, are interconnected and interdependent. It can then be inferred that human practices have been harmful to the cyclical process of nature, with production systems causing degradation through overexploitation.

However, according to the B13 statement, there is a perception that there are groups that manage to live causing minimum adverse impact to the environment. These groups are commonly exemplified by traditional communities, most of them having respectful relationships with nature and living beings.

According to the respondents, apparently there is no hierarchization between social and environmental problems; both need attention, and one can directly or indirectly influence the other, as indicated by 85.4% of the participants for statement B4. About this aspect, Santiago (2015) points out how the economic development has caused damages to the environment due to overexploitation actions driven by the Brazilian capitalist model, which have benefitted the rich to the detriment of the poor. This situation has a negative

impact on social practices less aggressive to nature and on the adoption of more sustainable measures, such as, for example, the implementation of clean energy sources.

It was noticed that statements B17 and B19 indicated an average of disagreement below 60%, slightly lower than the others in the rating scale, as well as around 20% in the central scale items. On the other hand, they were the statements that had the highest rate of agreement (around 20%). They are related to natural exploitation and human survival. About this issue, respondents may have understood the need for use of natural resources to ensure their survival and wondered how this could be achieved without changing nature. In fact, all actions, no matter how small they can be, cause changes in natural processes. However, there is a need to carry them out in such a way that the impact is minimal: managing and controlling exploitation and treating wastes are possible solutions.

The biocentric category achieved Cronbach's Alpha of 0.605. In this section, all statements achieved an agreement of more than 85%, indicating more equitable perceptions related to biological diversity.

Chart 2. Distribution of frequencies about biodiversity expressed in percentage: biocentric category

Item		Totally agree	Agree	Neither agree nor disagree	Disagree	Totally disagree
B7	There could be a balanced relationship between all living beings in the planet.	34.8	50.9	8.0	6.3	--
B8	Better to invest in biological control than in pesticides.	59.8	30.4	8.9	0.9	--
B9	Humans are superior to nature and other living beings	67.0	19.5	6.3	2.7	4.5
B12	Environmental problems affect directly the way of life of all living beings.	62.5	28.5	4.5	3.6	0.9
B16	All living beings have equal rights to live on the planet.	67.0	25.8	2.7	1.8	2.7
Cronbach's Alpha: 0.605; Tukey's test: <0.001; Average overall rating: 1.59.						

Source: Authors.

To 86.5% of respondents, humans are not superior to the other living beings (B9). Understanding that our species, as well as others, is part of a natural whole, is crucial if rethinking our attitudes towards the environment is at issue. Also, recognizing that environmental problems affect communities is shown by the agreements (89%) with B12.

The right to life and survival of all living beings (B16) was considered by 92.8% of the subjects. As Wolkmer & Paulitsch state (2011, p. 230-231), "If the future is the result of actions taken in the present, today it looks worrisome; thus, politics, economy, law and other areas have the challenge to join their knowledge and seek alternatives that promote Life in our planet." The bioethics imperative, of recognition of the intrinsic value of living beings, underlines the need for a change in mindsets, actions and relations with nature towards considerations that go beyond human species, as a way of critically assessing decisions to solve environmental crises (Junges, 2001; Levai, 2011; Wolkmer & Paulitsch, 2011).

Based on B7, we can perceive indications of agreement (85.7%) that there is a possibility of more equitable relationships between species and nature. About this, the great challenge is to find out how to make them practical and accessible to everyone, as a way of ensuring quality of life to living beings and diminish adverse environmental impacts.

For the B8 statement, which mentions pesticides and biological control, there was an agreement of 90.2%. This subject has been largely discussed, especially in Brazil, which, according to Carneiro (2015), is a world leader in the use of pesticides.

Disintegration Category

The Cronbach’s Alpha for the disintegrating view of biodiversity was of 0.657. It was the category with the greatest number of marks in the central rating scale (around 25%), a tendency that shows no positioning towards these issues, which is confirmed by the average overall rating (3.34).

Chart 3. Distribution of frequency of biodiversity expressed in percentage: disintegrating perspective

Item Valid percentage (%)		Totally agree	Agree	Neither agree nor disagree	Disagree	Totally disagree
		Valid percentage (%)	Valid percentage (%)	Valid percentage (%)	Valid percentage (%)	Valid percentage (%)
B2	Man can only preserve nature by keeping it untouched	5.4	9.8	26.8	46.4	11.6
B6	Artistical expressions, traditional knowledges and beliefs are not part of nature	4.5	17.0	23.1	27.7	27.7
B14	If human beings did not exist, nature would be in balance.	20.5	20.5	37.6	14.3	7.1
B15	Man should keep distance from nature	--	1.8	16.9	41.1	40.2
B20	Only science can teach about biodiversity	6.3	8.0	16.9	43.8	25.0
B24	Any community, even the traditional ones, harm biodiversity.	1.8	11.6	33.9	38.4	14.3
Cronbach’s Alpha: 0.657; Tukey’s Test: < 0.001; Average overall rating: 3.34.						

Source: Authors.

Not considering the neutral element (neither agree nor disagree) the statements B15 – “Man should keep distance from nature”, B2 – “Man can only preserve nature by keeping it untouched”, and B24 – “Any community, even the traditional communities, harm biodiversity”, obtained 81.3%, and 58% and 52.7% of disagreement, respectively. But statement B14, which brings a similar interpretation – “If human beings did not exist, nature would be in balance”, achieved 41% of agreement, which shows controversial or somehow immature perceptions of the respondents about the influence of the presence of man in nature, whether positive or negative. This debate is not recent and is cited by authors such as Almeida & Franzolin (2021), who found in a literature review, the prevalence of fragmented views of nature, where people cannot perceive themselves as part of biodiversity.

For statements B20 (68.8% of disagreement) and B6 (55.4% of disagreement), which present possibilities of dealing with biodiversity, it could be seen that the respondents consider that other subjects, not only the scientific ones, can teach about the biological diversity perspectives, in which political, social, ethical, economic and cultural aspects are included. Such comprehensive proposals are considered biocultural because

they emphasize individual and collective relationships between cultural and biological diversity (Toledo, & Barrera-Bassols, 2015). Our conclusion indicates a still incipient debate between culture and biodiversity.

C) QUESTIONS ABOUT SINGULARITIES

Of the four sections initially proposed for investigation of the empathy among the singularities of Brazilian minority groups, inclusion/exclusion, women’s triple shift, beliefs and socioeconomic diversities, only the socioeconomic and inclusion/exclusion singularities reached the minimum Cronbach’s Alpha index.

It was found that the validated categories for socioeconomic and inclusion/exclusion singularities achieved low overall averages, 1.46 and 1.53, respectively. This means that, in general, the participants of this study understand the importance of empathy for the groups represented in the statements.

Socioeconomic Category

The socioeconomic category (Chart 4) had a Cronbach’s Alpha of 0.633.

Chart 4. Distribution of frequencies of singularities expressed in percentage: socioeconomic category

	Item	Totally agree	Agree	Neither agree nor disagree	Disagree	Totally disagree
S8	Low-income people have more difficulties completing school and college. (+)	69.6	25.0	4.5	--	0.9
S9	People of high economic classes have more advantages in the current academic model. (+)	75.9	19.6	2.7	1.8	--
S11	Scholarships are indulgent, lenient to people. (-)	--	2.7	5.4	19.6	72.3
S16	Individuals who work while completing their degree are more likely to drop out of school. (+)	46.5	39.3	9.8	3.5	0.9
S22	Low-income individuals should receive financial and psychological support from higher education institutions. (+)	58.9	33.9	3.6	2.7	0.9
Cronbach’s Alpha: 0.633; Tukey’s test: < 0.001; Average overall rating: 1.46.						

Source: Authors.

It can be seen a high degree of empathy for the socioeconomic issue as a significant influence in the educational processes (mean = 1.46). The statements show how income distribution can impact the access and permanence in schools and universities, which is emphasized by the high percentage of agreement for S8 (94.6%) and S9 (95.5%). Together with statement S16, about which 85.8% of respondents agree about the difficulty in studying and working at the same time, because both activities require high demand of time and mental effort, it should be emphasized that a high level of demands may have an adverse impact on the activities of one or another task. That is possibly why 92.8% of the participants agreed with the need for financial and psychological support for low-income students (S22) and disagreed (91.9%) with statement S11, commonly used by meritocratic political discourses that scholarships are indulgent and “spoil” people.

When they presented the results of studies that examined the associations between access inequalities and permanence in higher education institutions, students' support services and the labor market for graduates from two public universities in Brazil, Vargas (2010) and Vieira, Constantino & Silva (2012) demonstrated how the percentage of access of low-income individuals to higher education institutions and the risk of not completing the courses is much higher than for high-class persons. These authors also emphasize how the support to low-income students can help them complete the course and obtain a degree and, even more, find qualified jobs in the labor market (Vargas, 2010; Vieira, Constantino, & Silva, 2012).

Inclusion/exclusion category

With Cronbach's Alpha of 0.688, the inclusion/exclusion category comprised 12 statements, which included questions about race/ethnicity, people with disabilities and LGBTQI+, reaching a mean overall average rating of 1.53 (Chart 5).

Chart 5. Distribution of frequencies of singularities expressed in percentage: inclusion/exclusion category

	Item	Totally agree	Agree	Neither agree nor disagree	Disagree	Totally disagree
S1	It should not be the State's obligation to provide for the permanence of traditional people (indigenous, <i>quilombolas</i> , etc.) in universities. (-)	1.8	0.9	4.5	24.1	68.7
S4	LGBTQI+ people are not more vulnerable to dropping out of school. (-)	4.5	13.4	12.5	25.8	43.8
S6	Black persons do not suffer more prejudice than others. (-)	2.7	4.5	2.7	18.7	71.4
S7	The State must guarantee access and permanence of people with disabilities in universities. (+)	83.9	13.4	1.8	--	0.9
S12	All educational institutions should take into consideration the individual's ethnicity. (+)	43.7	35.7	15.2	4.5	0.9
S14	People with disabilities should not pursue university careers. (-)	2.7	--	0.9	9.8	86.6
S19	All people must be treated equally, regardless of ethnicity. (+)	83.0	13.4	0.9	1.8	0.9
S20	An individual only becomes LGBTQI+ because he/she suffered some kind of abuse. (-)	0.9	1.8	--	14.3	83.0
S23	Universities should not provide assistance to people with disabilities. (-)	3.6	0.9	0.9	11.6	83.0
S24	People with disabilities find it more difficult to complete university courses. (+)	37.5	36.6	21.4	3.6	0.9
S25	LGBTQI+ people have more difficulties in their professional careers. (+)	40.2	47.2	5.4	4.5	2.7
S26	Every LGBTQI+ person must be who he/she really is and not hide. (+)	58.0	31.3	7.1	0.9	2.7
Cronbach's Alpha: 0.681; Tukey's test: < 0.001; Average overall rating: 1.53.						

Source: Authors.

Based on S6 statement (“Black persons do not suffer more prejudice than others”), which obtained 90.1% of disagreement, we noticed the perception of a recurrent situation in the Brazilian society, where black people deal with racism every day. According to Queiroz (2004), even being the country with the largest number of black persons outside the African continent, social opportunities are not the same as those offered to white individuals. Due to the long period of slavery of Africans in our country, not even “freedom” was able to put an end to the suffering of these individuals. Left at the mercy of society, far from their origins, without a house and adequate food, they were practically obliged to continue in primary and unskilled, heavy work to survive (Queiroz, 2004). The racism suffered does not seem to have diminished over time, because situations of prejudice are experienced every day by black individuals, either men or women.

As a way to change this picture, Queiroz (2004) points to the need to admit that race is an element that generates inequality in our country, so that a critical adoption of public policies should be considered. By agreeing with statement S19 (96.4%), most of the respondents seem to recognize the importance of deconstructing this discriminatory approach.

Education is a key element for the deconstruction of inequalities, including racial and ethnic, especially considering the associated Brazilian diversity. As an example of actions taken to equalize opportunities, we can cite the racial quotas for blacks, indigenous people and *quilombolas* (Cordeiro, 2012). This view seems to be shared by a large number of respondents when we examine the disagreement (92.8%) with statement S1 (“It should not be the State’s obligation to provide for the permanence of traditional people [indigenous, *quilombolas*, etc.] in universities) and the agreement (79.4%) with item S12 (“All educational institutions should take into consideration the individual’s ethnicity”).

With respect to people with disabilities, we perceive that for statements S7, S14 and S23, which achieved more than 90% of agreement, the State should guarantee the access and permanence of these people in universities, if they so desire. These rights are already provided for in Law nº 13.409, of 2016 (Brazil, 2016), which determines that a certain number of vacancies must be saved for disabled people in technical courses of secondary level and higher education in federal education institutions.

There was a lower approval for item S24 (“People with disabilities find it more difficult to complete university courses”) (74.1%) if compared to the other statements, with 21.4% of marks in the central scale rating. It should be understood that the statement that says that people with disabilities have more difficulties does not mean discriminating them, but that it is necessary to provide educational facilities to serve them, that is, it is not the individual with disability who should adapt to the university; on the contrary, or at least, there should be mutual adaptation.

Considering the statements relating to LGBTQI+, we bring discourses that illustrate some of the discriminations suffered by these individuals, which are associated with the right to express gender and sexual orientation. It is very common in discriminating speeches, which we certainly disapprove, the idea that these multiple identifications result from traumas, abuses, psychological problems, etc. Considering S20, we can see that 97.3% of participants disagree with this statement.

For S26, in turn, 89.3% of respondents agree with the statement (“Every LGBTQI+ person should be who he/she really is and not hide”), and this point deals directly with the behavior of this group. Social acceptance seems to be associated with their appearance, how they dress or show affection, for example. About this, Almeida (2021) mentions how heterosexist discourses, such as “this is so gay”, are used as a negative reference to LGBTQI+ people, seeking to dictate which kind of behavior is or not socially acceptable.

Santos (2017), in a case study about the condition of being LGBT and completing a course at a public Brazilian university, demonstrated how male and female students do not show their true sexual orientation in the academic environment for fear of exclusion and aggression and insecurity. Based on statement S4, 69.6% of participants perceive this situation, which ends up making it difficult for LGBTQI+ people to stay

in the university and complete the course. In the same line of thinking, 87.4% agree with statement S25, which emphasizes the difficulties of these individuals in pursuing a professional career.

D) CORRELATIONS BETWEEN BIODIVERSITY AND SINGULARITY CONCEPTIONS

Chart 6 presents the comparative result between biodiversity and singularities categories as descriptors of sociocultural diversity. Two significant and positive correlations can be inferred from the Chart: between biocentric, socioeconomic alterity and inclusive/exclusive empathy.

Chart 6. Correlation between Socioeconomic and Inclusion/Exclusion Singularities and Biocentric categories

	Biocentric
Socioeconomic	0.222*
Inclusion/Exclusion	0.307*

*. Correlation is significant at the level of 0.05 (2 extremities).

Source: Authors.

Based on the first correlation between the biocentric and socioeconomic latent variables, we can see that people who are more sensitive to the diversity of classes and socioeconomic inequality tend to be more biocentric. Likewise, there is a significant positive correlation between the more inclusive and more biocentric responses, which possibly means that, for this group, there is an approximation of cultural and biological diversity perceptions – which is especially evident by the recognition that goes beyond control and objectivation, but recognizes and respects interspecific alterities. Propositions of Ingold (1995) and Pérez, Moscovici & Chulvi (2002) confirm the need for a thoughtful consideration for living beings who fight against propositions of hierarchical levels among them.

Recognizing alterities may allow the construction of a more equitable, fair and democratic society for all species, in which freedom of expression of one's own particularities and those of others is assured. Realizing these differences, I think about my own singularity and understand that the right to life extends to all beings.

A more caring, diplomatic, intrinsic and familiar relationship with nature helps build self-knowledge and knowledge of other living beings and natural elements. Such association brings to light intrapersonal elements, such as feelings and memories, which can reconnect us with nature (Pagan, 2021). Thus, when we begin to respect nature and living beings, in general, it is possible to be more sensitive to the singularities of ethnic/racial groups, people with disabilities, LGBTQIA+ and socioeconomically vulnerable people, and vice-versa.

In the training of biology teachers, it can be seen the potential to work on the subject of biodiversity and singularities in an interdisciplinary manner, allowing students to intersect components and build a more comprehensive view about the topic.

FINAL CONSIDERATIONS

Considering the possibilities of understanding the conceptions of biodiversity by biology undergraduates and professionals, through anthropocentric, biocentric integrating and disintegrating categories, we realize that the debate on anthropocentrism and biocentrism is present in the personal and academic daily life of the participants of this study. Based on the results of this study, we can also see that more biocentric perceptions have been increasingly recognized and embraced, while anthropocentric perceptions are viewed as outdated. However, there is a need to assume more equitable positions toward living beings and nature in the most recurrent practices of all social sectors, especially in the educational and political sphere, so that

solutions can be critically built to reverse the environmental crisis and ensure a truly sustainable survival.

With respect to the integrating and disintegrating categories, we noticed that the debate is timid when it comes to understanding the relation between cultural diversity and biological diversity. This can be inferred from the participants' answers to these topics, with opinions sometimes controversial, contradictory, so it is necessary to pay more attention to discursive constructions of this association, specifically.

The positive correlations of the biodiversity biocentric category with the socioeconomic and inclusion/exclusion singularities categories corroborate our initial hypothesis that the recognition of both diversities can be related. In this case, respect and thoughtfulness for low-income people, individuals with disabilities and those who suffer racial/ethnic, gender and sexual orientation discrimination, are associated with empathy with other living beings. This analysis somehow makes us think that biology courses could contribute to a reduction of racial and gender prejudices, for example.

So, our results suggest an important association between intraspecific and interspecific alterities and also that is necessary to associate, in biology classes, discussions about human subjectivities with those about life diversity, seeking interdisciplinarity. Humanization in teaching training courses suggests an integrating and considerate look that goes beyond technical and rationalized aspects and appears to be relevant in themes such as biological diversity, especially when it is associated with environmental issues, because of the need to sensitize and engage individuals in effectively sustainable practices and promote resistance of knowledges and local practices.

REFERENCES

- Almeida, R. A. C. P. de. (2021). *Bullying homofóbico no ensino superior: vivências da Comunidade LGB*. (Dissertação de Mestrado). Universidade de Évora. Portugal.
- Almeida, E. A. E. de, & Franzolin, F. (2021). Recomendações para o ensino de biodiversidade. *VIII Encontro Nacional de Ensino de Biologia, VIII Encontro Regional Nordeste de Ensino de Biologia, II Simpósio Cearense de Ensino de Biologia* (online).
- Boton, J. de M., Costa, R. G. de A., Kurzmann, S. M., & Terrazan, E. A. (2010). O meio ambiente como conformação curricular na formação docente. *Rev. Ensaio*, Belo Horizonte, 12(3), 41-50.
- Brasil. Lei nº 13.049, de 28 de dezembro de 2016. (2016). *Altera a Lei nº 12.711, de 29 de agosto de 2012, para dispor sobre a reserva de vagas para pessoas com deficiência nos cursos técnico de nível médio e superior das instituições federais de ensino*. Brasília: Diário Oficial da União.
- Cardoso, D. M. (2014). Dimensões, centralidade e transversalidade da cultura. Cardoso, D. M.; Lima, S. M. S.; Fernandes, S. C. L. *Diversidade Cultural e Desenvolvimento*. Assessoria de Educação a Distância UFP: Belém/Pará. Recuperado em 01 Fevereiro, 2022, de https://aedmoodle.ufpa.br/pluginfile.php/107219/mod_resource/content/0/eixo_2_diversidade_cultural_e_desenvolvimento/Book_Curso_de_Gesta_o_Cultural_revisao02_final.pdf#page=17
- Carneiro, F. F. (Org.). (2015). *Dossiê ABRASCO: um alerta sobre os impactos dos agrotóxicos na saúde*. São Paulo: Expressão Popular.
- Cordeiro, M. J. de J. A. (2012). Cotas no ensino superior: ação de resistência contra o racismo e de ascensão social de negros e indígenas. *Revista de C. Humanas*, Viçosa, 12(2)357-369.
- Cunha, L. M. A. da. (2007). *Modelos Rasch e Escalas de Likert e Thurstone na Medição de Atitudes*. (Dissertação de Mestrado). Universidade de Lisboa, Faculdade de Ciências.
- Faustino, M. T., Roberto, E. C. de O., & Silva, R. L. F. (2017). Utilizando um mural digital para investigar significados da biodiversidade apresentados por professores (as). *X Congresso Internacional Sobre Investigación en Didáctica de Las Ciencias*. Sevilla.
- Furtado, J. (2016). Docência e alteridade. *Congresso de Educação Básica – Aprendizagem e Currículo*.
- Guimarães, P. R. B. (2003). *Análise de Correlação e Medidas de Associação*. Universidade Federal do Paraná, Curitiba.

Recuperado em 10 ago. 2022, de <https://docs.ufpr.br/~jomarc/correlacao.pdf>

IBGE – Instituto Brasileiro de Geografia e Estatística. (2012). *Censo Brasileiro de 2010*. Rio de Janeiro.

Ingold, T. (1995). *Humanidade e Animalidade*. Recuperado em 30 Maio, 2021, de <http://www.iea.usp.br/eventos/destaques/ingold-humanidade> Jacobi, P. R., Empinotti, V., & Toledo, R. F. de. (2015). Gênero e meio ambiente. *Ambiente & Sociedade*.

Junges, J. R. (2001). Ética ecológica: antropocentrismo ou biocentrismo? *Persp. Teol.*, 33, 33-66.

Kato, D. (Org.). (2020). *Bionas para formação de professores de biologia: experiências no observatório da educação para biodiversidade*. São Paulo: Editora Livraria da Física.

Kawasaki, C. S., & Oliveira, L. B. de. (2003). Biodiversidade e educação: as concepções de biodiversidade dos formadores de professores de biologia. *IV Encontro Nacional de Pesquisa em Educação em Ciências*. São Paulo.

Levai, L. F. (2011). Ética ambiental biocêntrica: pensamento compassivo e respeito à vida. *Revista Eletrônica de Ciências Jurídicas e Sociais da Universidade Cruzeiro do Sul*, São Paulo, 1(1).

Lévêque, C. A. (1999). *Biodiversidade*. Baurú: Editora da Universidade do Sagrado Coração.

Maroco, J., & Garcia-Marques, T. (2006). Qual a Fiabilidade do Alfa de Cronbach? Questões Antigas e Soluções Modernas? *Instituto Superior de Psicologia, Laboratório de Psicologia*, Portugal, 4(1), 65-90.

Marques, J. B. V., & Freitas, D. de. (2018). Método DELPHI: caracterização e potencialidades na pesquisa em Educação. *Pro-Posições*, 29(2).

MMA – Ministério do Meio Ambiente. (2000). *Convenção da diversidade biológica – Cópia do Decreto Legislativo no. 2, de 5 de junho de 1992*. Brasília: MMA.

Oliveira, C. A. V. de. (2008). O conceito de diversidade cultural e suas implicações para a formação do professor de matemática no interior de Mato Grosso: estudo de caso com licenciandos em Matemática na UNEMAT. *EDUCERE*. Recuperado em 20 jan. 2022, de https://educere.bruc.com.br/arquivo/pdf2008/159_896.pdf

Pagan, A. A. (2009). *Ser (animal) humano: evolucionismo e criacionismo nas concepções de alguns graduandos em Ciências Biológicas*. (Tese de Doutorado em Educação). Faculdade de Educação da Universidade de São Paulo. São Paulo/SP.

Pagan, A. A. (2018). O ser humano do Ensino de Biologia: uma abordagem fundamentada no autoconhecimento. *Revista entreideias*, 7, 73-86. Recuperado em 20 abr. 2021, de <https://periodicos.ufba.br/index.php/entreideias/article/view/26530>.

Pagan, A. A. (2020). Entre o bélico e o diplomático: transicionar a ciência como possibilidade de humanizar a educação ambiental. *Revista Sergipana de Educação Ambiental*, 7, 1-19.

Pagan, A. A., Scanavaca, R. P., Marin, Y. A. O., Cassiani, S. & Maciel, M. R. A. (2021). Cosm visões etnocientíficas no ensino de biologia: algumas reflexões. Urban, S. P. *Conhecimento popular e acadêmico em diálogo: educação e práticas emancipatórias*.

Pérez, J. A., Moscovici, S., & Chulvi, B. (2002). Natura y cultura como principio de clasificación social: anclaje de representaciones sociales sobre minorías étnicas. *Revista de Psicología Social*, 17(1), 51-67.

Queiroz, D. M. (2004). O negro e a universidade brasileira. *História Actual Online*, (3), 73-82. Recuperado em 11 jan. 2022, de https://www.researchgate.net/publication/26507473_O_negro_e_a_universidade_brasileira

Redação Lado A. (2017). *Gênero fluido e sexualidade: entenda as variações possíveis*. Recuperado em 02 jan. 2022, de <https://revistaladoa.com.br/2013/08/noticias/professora-transsexual-gaucha-diz-que-escola-ainda-um-espaco-homofobico-transfobico/>

Rédua, L. de S., & Kato, D. S. (2017). A formação de professores e as controvérsias envolvendo a biodiversidade: análise a partir do banco de teses e dissertações do grupo EArte. *IX Encontro de Pesquisa em Educação Ambiental*. Minas Gerais.

Santana, A. M. (2017). Inovação inclusiva e singularidades: um estudo com licenciados de ciências biológicas da UFS. (Dissertação de Mestrado em Ciências e Matemática). Universidade Federal de Sergipe. São Cristóvão/SE.

Santiago, D. R. (2015). Crescimento econômico, pobreza e meio ambiente: perspectivas atuais dessa relação. *Pensamento Verde*. Recuperado em 02 jan. 2022, de <https://www.pensamentoverde.com.br/sustentabilidade/crescimento-economico-pobreza-e-meio-ambiente-perspectivas-atuais-dessa-relacao/>

Santos, I. M. dos, Almeida, C. S. de, Santos, A. E. dos, Nascimento, G. E. C. do & Pagan, A. (2021). Percepções sobre biodiversidade e singularidades: construção e validação de um instrumento de coleta de dados. *XIII Encontro Nacional de Pesquisa em Educação em Ciências*. Campina Grande/PB. Recuperado em 03 jan. 2022, de <https://www.editorarealize.com.br/index.php/artigo/visualizar/76428>.

Santos, J. B dos. (2017). A condição de ser LGBT e a permanência na universidade: um estudo de caso no curso de pedagogia - educação do campo. *IV Colóquio Internacional de Pesquisas em Educação Superior*.

Silva, N. (2018). *População urbana e rural no Brasil: análise comparativa dos percentuais segundo critérios do IBGE e da OCD. A nova democracia*. Recuperado em 02 jan. 2022, de [https://anovademocracia.com.br/noticias/10028-populacao-urbana-e-rural-no-brasil-analise-comparativa-dos-percentuais-segundo-criterios-do-ibge-e-daocde#:~:text=Segundo%20o%20Censo%20do%20IBGE,986%20pessoas\)%20em%20C3%A1reas%20rurais](https://anovademocracia.com.br/noticias/10028-populacao-urbana-e-rural-no-brasil-analise-comparativa-dos-percentuais-segundo-criterios-do-ibge-e-daocde#:~:text=Segundo%20o%20Censo%20do%20IBGE,986%20pessoas)%20em%20C3%A1reas%20rurais).

Thirty Seven Trend News. (2019). *Nova Geração de Ativistas Ambientais que Você Precisa Conhecer!* Recuperado em 23 nov. 2022, de <https://www.thirtyseptrend.com/nova-geracao-de-ativistas-ambientais-que-voce-precisa-conhecer/>

Toledo, V. M., & Barrera-Bassols, N. (2015). *A memória biocultural – A importância ecológica das sabedorias tradicionais*. São Paulo: Editora Expressão Popular.

Vargas, M. de L. F. (2011). Ensino superior, assistência estudantil e mercado de trabalho: Um estudo com egressos da UFMG. *Avaliação*, Campinas; Sorocaba, SP, 16(1), 149-163.

Vieira, J. C. de A., Constantino, J. A., & Silva, M. A. de S. (2012). Assistência estudantil no ensino superior: um estudo sobre o perfil dos estudantes usuários do Programa de Bolsas de Permanência da UAG/UFRPE. *REVASF*, 1(2).

Wolkmer, M. de F. S., & Paulitsch, N. da S. (2011). Ética ambiental e crise ecológica: Reflexões necessárias em busca da sustentabilidade. *Veredas do Direito*, Belo Horizonte, 8(16), 211-233.

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