

## BIOLOGICAL AND CULTURAL DIVERSITY IN BIOLOGY TEACHER FORMATION: ANY RELATION?

### *DIVERSIDADE BIOLÓGICA E CULTURAL NA FORMAÇÃO DE PROFESSORES DE BIOLOGIA: ALGUMA RELAÇÃO?*

### *DIVERSIDAD BIOLÓGICA Y CULTURAL EN LA FORMACIÓN DE PROFESORES DE BIOLOGÍA: ¿ALGUNA RELACIÓN?*

Isabela Mayara dos SANTOS<sup>1</sup>  
Alice Alexandre PAGAN<sup>2</sup>

**ABSTRACT:** In this work, we aim to discuss, qualitatively, possible associations between biological diversity and cultural diversity in the formation of biology teachers. These reflections can broaden the understanding of the relationship between society and nature, as well as the construction of curricula for the degree in biology. We approach some ecological perspectives of biodiversity and cultural diversity; in this one, we demarcate the perceptions of individual and collective singularities as a possible descriptor of a contemporary sociocultural profile. Seeking to approximate diversities, we present the biocultural and biocentric approaches, and the possibility of inserting integrating, disintegrating, biocentric and anthropocentric elements to analyze the perceptions of undergraduates. We conclude that the recognition of the relationships between particularities/collectivities and the themes related to the variability of living beings helps in the process of social emancipation of the teacher in training. Furthermore, we consider that a biocentric approach, based on equity, enables the recognition of the interspecific alterities of living beings, providing (re)connection, (re)integration and diplomatic coexistence.

**KEYWORDS:** Interspecific alterities. Biocentrism. Singularities.

**RESUMO:** Neste trabalho, objetivamos discutir, qualitativamente, possíveis associações entre diversidade biológica e diversidade cultural na formação de professores de biologia. Essas reflexões podem ampliar o entendimento das relações entre sociedade e natureza, bem como a construção de currículos para a licenciatura em biologia. Abordamos, algumas perspectivas ecológicas de biodiversidade e diversidade cultural; nesta, demarcamos as percepções das singularidades individuais e coletivas como possível descritor de perfil sociocultural contemporâneo. Buscando aproximar as diversidades, apresentamos as abordagens biocultural e biocêntrica, e a possibilidade de inserção de elementos integradores, desintegradores, biocêntricos e antropocêntricos para análise das percepções de licenciandos. Concluimos que o reconhecimento das relações entre particularidades/coletividades e as temáticas relacionadas à variabilidade dos seres vivos auxilia no processo de emancipação

<sup>1</sup> Federal University of Sergipe (UFS), São Cristóvão – SE – Brazil. Master in Science and Mathematics Teaching. ORCID: <https://orcid.org/0000-0002-4609-890X>. E-mail: isamay2@hotmail.com

<sup>2</sup> Federal University of Mato Grosso (UFMT), Cuiabá – MT – Brazil. Associate Professor, Department of Biology and Zoology, Institute of Biosciences (IB). PhD in Education (USP). ORCID: <https://orcid.org/0000-0002-9757-4304>. E-mail: [alice.pagan@ufmt.br](mailto:alice.pagan@ufmt.br)

*social do professor/professora em formação. Ademais, consideramos que uma abordagem biocêntrica, baseada na equidade, possibilita o reconhecimento das alteridades interespecíficas dos seres vivos, proporcionando a (re)conexão, a (re)integração e a convivência diplomática.*

***PALAVRAS-CHAVE:*** *Alteridades interespecíficas. Biocentrismo. Singularidades.*

***RESUMEN:*** *En este trabajo, pretendemos discutir, cualitativamente, posibles asociaciones entre diversidad biológica y diversidad cultural en la formación de profesores de biología. Estas reflexiones pueden ampliar la comprensión de la relación entre sociedad y naturaleza, así como la construcción de currículos para la carrera de biología. Abordamos algunas perspectivas ecológicas de la biodiversidad y la diversidad cultural; en éste, delimitamos las percepciones de las singularidades individuales y colectivas como posible descriptor de un perfil sociocultural contemporáneo. Buscando aproximar las diversidades, presentamos los enfoques biocultural y biocéntrico, y la posibilidad de insertar elementos integradores, desintegradores, biocéntricos y antropocéntricos para analizar las percepciones de los estudiantes de grado. Concluimos que el reconocimiento de las relaciones entre particularidades/colectividades y los temas relacionados con la variabilidad de los seres vivos ayuda en el proceso de emancipación social del profesor en formación. Además, consideramos que un enfoque biocéntrico, basado en la equidad, posibilita el reconocimiento de las alteridades interespecíficas de los seres vivos, propiciando la (re)conexión, la (re)integración y la convivencia diplomática.*

***PALABRAS CLAVE:*** *Alteridades interespecíficas. Biocentrismo. Singularidades.*

## **Introduction**

Considering how, in recent years, the environmental crisis has worsened and damaged the wealth and abundance of species on the planet, it is crucial that we rethink our relationship with the environment, since our species and the others are interconnected with nature, in an interdependent association. About this, Pagan (2020) reports that the search for understanding natural elements from a perspective of control of other living beings has disconnected and separated us from other species, which may hinder the adoption of environmental justice and ecologically diplomatic practices.

Discussing biological diversity opens up precedents for different approaches, ranging from the ecological perspective, typical of scientific studies related to looks that separate subject and object, to the social, political, cultural, ethical, and economic inclusions in the discussion of this matter. The relationship between these perspectives is much debated in Brazil, which is a country rich in both biological and cultural diversity. Despite this, the environmental issues inherent to biodiversity are, in general, based on anthropocentric elements, centered on the

human species and its "needs", which has hindered effective actions for environmental recovery, preservation, and conservation.

Thus, discussing possible associations between biological and cultural diversity broadens the scope of the relations between society and nature, enabling new approaches to the socio-environmental theme, as well as questioning discriminations and hierarchizations, and possibly reducing exclusionary and silencing processes. These reflections may also allow a more communitarian conformation among all living beings, based on the recognition of the intrinsic value of individuals and the need for balance in the coexistence of the collective inhabitants of this planet.

In this work, we try to associate the theme of biological diversity with cultural diversity, based on the hypothesis that the perception and respect for the singularities of all living beings are related, that is, the acceptance of diversity in our own species is related to the acceptance and understanding of diversity in others. We can recognize ourselves as human diversity from the respect for the variability of living beings. In this sense, we question whether less sexist, homophobic, and meritocratic attitudes can lead to less speciesist positions, configuring greater harmony among all species.

In the training of biology teachers, we seek to propose greater attention to activism for diversity, with a view to inclusion. About this, we apparently face a gap between two fields of debate that seem to interact very little: environmental activism and social activism. It is not uncommon to find, on one side, discourses on environmental preservation and conservation disconnected from social needs, and on the other, those who defend social equity without any mention of the collective needs of other species inhabiting the planet.

However, today, both biological and cultural diversity are central concepts in the training of biology teachers. One of the most important questions that we attack in this process is: how can our species exist in a prosperous way, guaranteeing diverse social needs, based on the relationships it establishes with the planet? Facing such questions, we have debated that diversity, be it ecological or social, is positive for the extension of our time of existence on earth. Thus, seeking to understand the possible intersections between these concepts can broaden our understanding of the construction of curricula for the biology undergraduate course.

Based on the analysis of educational processes and training of biology teachers, Pagan *et al.* (2021) discussed how biology, whose discussions build meanings about living beings, can reflect on our conceptions of who we are as humanity, individually and collectively. As an unfolding of this concern, we ask ourselves: are there sociocultural profiles that point to

indicators about which teachers and students have greater or lesser sensitivity to biodiversity? Based on this question, this paper aims to relate aspects of biological diversity and cultural diversity in the context of biology teacher education.

To this end, we first discuss some ecological perspectives on the concept of biodiversity. In a second moment, we discuss cultural diversity, a topic in which we demarcate the perceptions of individual and collective singularities as a possible descriptor of the contemporary sociocultural profile. And, finally, as a way to approach the discussions between biological diversity and cultural diversity, we present the biocultural and biocentric approaches, and discuss the possibility of inserting integrative, disintegrative, biocentric, and anthropocentric elements to analyze the perceptions of biology undergraduates, moving towards the point that we defend as fundamental in this article, the interspecific alterities as a key element for the deepening of equitable relations among diversities..

## **Biological Diversity**

The relations of our species with the others that inhabit or have inhabited the planet are as old as the formation of humanity itself (FRANCO, 2013). The fascination with the variety of forms and behaviors of animals and plants, the need for food and their use in daily work have led individuals to seek to classify and quantify, even if in a rudimentary way, their terrestrial companions. Despite the references of several studies on the cruciality of protecting and recovering the variability of living beings (BARBIERI, 2010; LÉVÊQUE, 1999; WILSON, 2012), the aggressions to the environment have increased alarmingly in recent decades. They directly threaten the biological balance, which, in turn, influences the quality of life of all beings.

It is also evident that the concepts and characteristics of the studies related to biological diversity were initially thought and developed in the scientific environment; therefore, it is clear that the first studies referred specifically to biological, ecological, genetic, and evolutionary proposals, aligned, for the most part, to the understanding and application of this knowledge for preservation, conservation, and/or sustainable use. Thus, the most popular definition of biological diversity in the scientific environment is presented in Article 2 of the Convention on Biological Diversity - CBD:

[...] the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems (BRAZIL, 2000, p. 9, our translation).

In Lévêque (1999, p. 16-18), these three basic levels, products of biological evolution and interconnected among themselves, are configured as follows: species diversity - corresponds to the quantification of individuals in a given geographical area; genetic diversity - based on studies of molecular biology, places the gene diversity among the same species; and ecological diversity - presents the complex particular relationships existing between organisms and the physical environments in which they live. Therefore, biodiversity can be studied from various parameters, from the narrowest such as species and genera, to the broadest, kingdoms and phyla. However, Wilson (2012, p. 29) states that "the concept of biological species is crucial for the study of biological diversity", because from it we can get a more defined and detailed approach to this variability.

In this way, the grouping in hierarchical levels of biodiversity, the result of long periods of biological evolution, configures the diversity of beings in a dynamic way, which has changed over time and continues to change today. Responses to environmental changes and mutations have allowed organisms to adapt to different environments on the planet, and provide a certain numerical stability and variability (LÉVEQUE, 1999; WILSON, 2012).

Human activities are, without a doubt, the main ones responsible for the disappearance of the diversity of life forms on the planet. Moreover, human beings themselves endanger their own well-being, since biodiversity is responsible for the availability of water and food necessary for their subsistence. Moreover, biological imbalances can cause undesirable events, such as the proliferation of pests and diseases, as well as increased emissions of carbon dioxide, one of the main causes of climate change (BONONI, 2010; IBERDROLA, 2021). The current pandemic of the new coronavirus is the most recent example that we must curb the degradation of natural areas to prevent the emergence of new zoonoses.

Balancing the protection of biological diversity and the use of natural assets is not an easy task. Several mechanisms must be used to achieve success, among which is the government's action in regulating the exploitation of hunting, fishing, land use and environmental pollution through laws and the creation of protected areas, such as conservation units (PRIMACK; RODRIGUES, 2001). As Primack and Rodrigues (2001) point out, conservation biology assumes the important role of seeking solutions to the current crisis of biological diversity. To this end, the authors propose: increasing the scientific record of species, seeking to understand the processes arising from genetic diversity; and understanding the trophic relationships within communities, intensifying the recording of key species, which affect the organization of other beings in the locality.

Thus, over time, several proposals for the preservation and conservation of biological diversity have been formulated, among which preservation proves to be more efficient; from this perspective, protection areas have been established, each with its own specificities, to safeguard the biological processes of the species. Among the restorative methods are reforestation practices, species reintroduction, monitoring of animals at risk of extinction, and the creation of conservation units, among others (PRIMACK; RODRIGUES, 2001).

## Cultural Diversity

When searching the literature for a definition of cultural diversity we come across a diversity of information based on anthropological, sociological, and philosophical aspects. A common controversy is whether the aspect of culture is proper of people or is contained in them; for the first hypothesis, it is considered that it is internal attribute of the subjects, while for the second, it corresponds to external elements that are adhered by individuals and social groups (OLIVEIRA, 2008). In this aspect, we can reflect on whether who we are and the choices we make come from within us or are shaped by society (family, school, religious groups, etc.).

Like Cardoso (2014) and Oliveira (2008), we rely on the premise that both statements are correct, and that cultural individualities and collectivities are dynamically constructed and reconstructed, with exchanges between the human essence (emphasized in anthropological studies) and external social influences (widely discussed by sociology).

As a way to understand cultural diversity, Cardoso (2014) proposes an analysis that is usually based on substantial aspects of culture, specifically on the symbols that compose it. These are elements endowed with meaning and, generally, are quite representative of the groups. In a simple way, we can cite, as an example, soccer team supporters who group around the same song, shield, and colors. Another example, quite complex, would be the recurrent cases of discrimination against black people who, because of their characteristic traits, are approached in a violent way and previously treated as guilty.

We understand, therefore, the constant change in sociocultural contexts by the changing character of pluralities, which are always adhering to new symbols and rules or excluding them, mainly due to the influence of historical and social transformations, or by individual and collective re-significations. Depending on the context, each culture may take on survival and resistance, if they are, even momentarily, threatened (FERREYRA, 2011).

We notice this situation when we talk about the so-called minorities that are present in the Brazilian territory. Although the term minority is associated with the meaning of

numerically smaller, when we deal with minority socio-cultural groups this relationship is not always established. Women are considered minorities when the lower remuneration compared to men's income is discussed, despite the fact that statistically they are the largest population in Brazil. Minorities are frequent targets of intolerance, discrimination, racism, and prejudice, especially in Brazil, which has unacceptable rates of death of the black community, femicide, and transfemicide, for example (CARMO, 2016).

To encompass such perspectives, there is a literary consensus in defining a social minority as groups that in certain specific situations may be deprived of exercising common equitable social roles, thus losing their identities, in a process that generates invisibilities, stereotypes, and vulnerabilities (CARMO, 2016). These challenges can provide a reflective process of their existence in the world and can shape social and academic aspects, which are reflected in their daily actions, learning processes, and professional praxis (PAGAN, 2018).

The democratization involved in the promotion and protection of sociocultural diversity has become, over the years, even more necessary, especially due to the increasing homogenizing processes, arising from globalization (CARDOSO, 2014). In seeking to standardize values, models and practices, there is inevitably silencing and exclusion. These are perceptible, for example, in the hierarchization of traditional and scientific knowledge, in the discrepant social demands between men and women, in the constant increase of homophobic attacks, in the opportunities and accessibility of the black community, in the stereotyping of rural communities, among others.

Although the globalization process favors communication between cultures around the world, the search for worldwide standardization has put cultural diversity at risk, especially in developing and underdeveloped countries, due, among other factors, to the unification of markets, the merger of audiovisual industries, and the imposition of power by some nations. Depending on their intellectual and technological level, some countries may not be able to resist the introduction of external cultural values, often causing local pluralities to become secondary. (CARDOSO; MUZETTI, 2007).

From these discussions, we realize that the term cultural diversity can unveil specificities associated with certain groups that make up our species. Among these characteristics, we can list, among others, ethno-racial, sexual, gender, religious, and demographic diversity, in order to characterize and give visibility to minority groups usually invisible or discriminated against from a standardizing conception of the patriarchal, heterosexual, cisgender, and European world, which has historically dominated the production of discourses and meanings in the collective context.

Despite the quite evident characteristics of cultural diversity, it is not only perceived in a visual way, it can be manifested internally and individually. Moreover, Gomes (2012, p. 2, our translation) reports that "[...] to talk about cultural diversity is not only about recognition, but means to think about the relationship between the self and the other. It is important to reflect on how these relations are configured: if they are fair, equitable, and communitarian, or of oppression, exclusion, and silencing.

In this way, we realize that cultural diversity can be identified in the formation of singularities and othernesses, that is, in the recognition of my individuality and that of others around me. It is from this variability that Gomes (2012) emphasizes the need for a more critical and political look at multiculturalism, for then, differences will be respected in their specificities and have equitable guarantees of social rights.

Therefore, it is understood that the formation of identity and cultural diversity is configured in a dynamic process of association between the self and the other, which is different from me, thus making it possible to discuss more diplomatic relations, not only with our own species, but also with other species on the planet, opening precedents for a more balanced coexistence (FURTADO, 2016; PAGAN, 2020).

It is also assumed that gender and identity characteristics, living in urban or rural areas, special needs, ethnicity and religious beliefs, family configurations, income and educational background, may reflect singularities, depending on the context in which they are identified and discussed. And these, in turn, may reveal characteristics that configure sociocultural diversity.

Considering the complexity of perceiving individualities, we chose to follow an identification system similar to the one used by Santana (2017), who described some singularities of biology undergraduates from sociodemographic characteristics. In our case, these characteristics will be those of Brazilian minority groups, which besides presenting markedly characteristic subjectivities, are in constant internal and social conflict of identity affirmation.

These social, cultural and subjective specificities would be biographical traits that make us unique in the world, and these ways reflect in the various environments we live, including the academic, which guides, for example, the ways in which we relate to colleagues, teachers and our learning processes (SANTANA; PARANHOS; PAGAN, 2017).

Santana (2017), from the association of singularities and inclusive innovation of undergraduates in Biological Sciences, came to the conclusion that our subjectivities, while differentiating us from other citizens, can provide a broader understanding of the world around



us, enhancing our intrapersonal and interpersonal relationships, which can be effective in cultural relations and more solidary associations with nature and living beings.

We seek, then, not only to think about characteristics that describe undergraduate biology students and teachers, but also to understand the relations of sensitivity that such students develop in relation to other minority groups, in an attempt to interpret whether certain profiles of uniqueness and sociocultural receptivity relate to greater recognition of interspecific otherness, and move towards more biocentric ideas in the perception of other species.

### **Biological and cultural diversity in science and biology teacher education: some approaches**

The aspect of diversity concerns the difference, which is not limited to those that are externally visible, but also to those that are more internal, which can be observed in a systematic way, and those that are being built throughout the history of social relations (GOMES, 2012). From this point of view, we can, for example, perceive in a visible way the cultural diversity of traditional peoples, or seek to understand processes of racism and discrimination of certain subjects from the analysis of their speeches, as well as reflect on how historical processes have proposed the silencing and marginalization of various groups.

Individual and collective particularities are not equally respected, since, socially, there is a patriarchal heteronormative standard of whiteness that tends to control or exclude everything that is different from it. In this logic, straight white men can be considered more "human" than women, homosexuals, traditional peoples, and blacks, and this has reflected in the forms of domination, exclusion, and enslavement present in the Brazilian formation. In parallel, animality brings this same distinction, bringing a vertical graduation of human beings and non-human beings, in which the former are falsely located in a level considered superior (INGOLD, 1995; PAGAN, 2020).

When discussing nature and culture as a principle of social classification, Pérez, Moscovici and Chulvi (2002) present the idea that some social groups are more integrable to the map of humanity than others, that is, animality would be derived from the natural, wild and instinctive, while culture to civility, to reasoning. This panorama has influenced the discrimination processes, which are predominantly presented in a latent form, not very manifest, and, for this reason, they argue that the understanding of social representations (social and collective individualities) would be more appropriate to understand these exclusion processes (PÉREZ; MOSCOVICI; CHULVI, 2002).

Thus, we agree with Marin (2020, p. 7, our translation), that there must be the overcoming of the opposition of differences, which stimulates exclusive processes of identities and cultures, being necessary the proposition of "[...] a logic of interaction with other beings that does not fall into a naive naturalistic view [...]", and that enables the coexistence of all forms of life. This coexistence has been widely debated in multiculturalist and interculturalist discussions. Multiculturalism defends plurality, heterogeneity, as a way to oppose the uniformity imposed by dominant groups. Its main features are linked to the right to differences, tolerance, democracy, and social justice. Readapting these items, interculturality proposes, in addition to respect and recognition of pluralities, coexistence and cultural interaction through dialogue (LOPES, 2012).

As a particular expression of biological diversity, cultural diversity enables a greater scope of explanation for the former. The preservation and conservation of natural elements can be more effective if there is "[...] community empowerment [...], empowerment of all - including women and children [...] and care for the environment that sustains local livelihoods" (LIBÂNEO, 1994, p. 4, our translation). In addition, Libâneo (1994) highlights proposals for intervention that seek to investigate ethnoecological perceptions, whose investigations are capable of broadly perceiving the diversity of ecological processes, as opposed to a single model of environmental approach.

Although Brazilian society presents great pluralism, and this multiplicity is foreseen in normative documents, there is a lack of effective actions that tend to distance theory from practice. An example of this is the constant struggles of Brazilian indigenous communities for the demarcation of lands, in opposition to government projects that affect traditional territories, resulting from mining activities, often illegal, and the expansion of agriculture and cattle raising. Considering also the intrinsic relationship between democracy and plurality, intertwined with the right to exercise difference, we understand that cultural diversity can provide subsidies for the discussion of eco-social relations, including with other species of living beings, recognizing their otherness.

Education is, without a doubt, one of the main tools to face sociocultural problems; this includes environmental ones, in which the biological diversity crisis is included. Besides defining the relevance of classifying and quantifying living things, discussions related to biodiversity need to address social, cultural, economic, political, and ethical aspects, thus increasing the scope for solving the associated crisis.

In the literature indicated in higher education training courses that cover the theme of variability of living things, it is notable that most present these conceptions focused on a

scientific/biological strand, in which specific, genetic, and ecological analyses are presented. In contrast, studies on the perception of undergraduates have shown the wide variety of meanings identified with regard to biodiversity, referring to their personal and community experiences with nature (FAUSTINO; ROBERTO; SILVA, 2017; KAWASAKI; OLIVEIRA, 2003; SANTOS; SANTOS; PAGAN, 2021) these can offer rich formative subsidies, even when they do not meet the requirements of the hegemonic Western scientific perspective.

In this sense, the proposition of an education for biodiversity presupposes the application of scientific concepts, with the association of individual and collective particularities, present in cultural diversity, with a view to the preservation and conservation of the natural balance, provided by the variability of beings. It can also be justified by the approximation of biological diversity with the services and uses related to human activities, from a socio-environmental perspective (KAWASAKI; OLIVEIRA, 2003).

The school, and consequently the other formative environments, were initially established for equality: reproduce standardized scientific knowledge, requiring students to use almost exclusively cognitive skills (TACCA; GONZÁLEZ-REY, 2008). However, these homogeneous didactics find in the heterogeneous cultural subjectivity of students a barrier that, even today, is difficult to overcome. In this case, undergraduate students feel challenged to incorporate subjective items in their students' learning, but need a training that gives them support for such.

It can be noticed that these subjects enter the university with individual and/or collective experiences of their own personal formative process, which are generally relegated to the background due to a historical standardization that exalts scientific knowledge over all others. On the other hand, in the pedagogical part of the training, the future teacher is oriented to take into consideration the previous concepts that his students may have. This contradictory didactics hinders the development of a consistent pedagogical practice, which meets the objectives of a science teaching for citizenship.

Considering the subjectivity of the teacher in training, it is impossible to separate his perceptions from his sociocultural insertion. It is in this sense that the conceptions of biological diversity are constructed, taking into account what is learned and what is lived. Thus, a more comprehensive perspective that also involves the individual, social, and cultural attributes of human life in the educational environment can help improve the relationship between human beings and nature, as well as identify means that dimension the conservation and preservation of natural elements, and ecologically sustainable practices.

## **Biocultural and biocentric approaches to biodiversity**

As a way to approach the discussions between biological diversity and culture, we present the biocultural and biocentric approaches, and then discuss the possibility of inserting integrative, disintegrative, biocentric, and anthropocentric elements to analyze the perceptions of biology undergraduates, moving towards the point that we defend as fundamental in this article, the interspecific alterities as a key element for the deepening of equitable relationships among diversities.

The proximity that individuals and communities have to nature shapes their environmental perceptions, practices, and thoughts. Thus, biological diversity may involve not only the quantification of living organisms, in biological terms, but also economic aspects, due to the removal of elements that are essential for human survival; ecological, due to its role in regulating the physical and chemical balance of the biosphere; ethical, which entails the human duty not to degrade the other forms of life on the planet (LÉVEQUE, 1999, p. 14-16); political, due to the responsibility of the people for the environment. 14-16); political, for the responsibility of nations to implement sustainable management modes of biodiversity (BRASIL, 1998); sociocultural, by understanding the unique relationships that individuals and communities have with nature (DIEGUES; ARRUDA, 2001; TOLEDO; BARRERA-BASSOLS, 2015), among others.

From this, we see the possibility of treating it under different aspects, which seem to start from the same basic principles, but may diverge in terms of the means and ends to which they are intended. Based on the analysis of Santos, Santos, and Pagan (2021), two other approaches that have emerged are: the biocultural, in which there is recognition of the various forms of connection of social groups with the environment, emphasizing the most sustainable experiences of use of natural elements; and the biocentric, whose bases highlight the essentiality of rethinking the position of our species towards others, based on ethical precepts of equitable rights to life and survival.

In general, the biocultural and biocentric perspectives of biodiversity, as classified by Santos, Santos, and Pagan (2021), emphasize that there is no possibility of dealing with coexistence relations, conservation, and protection of other species and the planet as a whole without including the human being, a social being, endowed with subjectivity and interrelationships, who carries with him his unique cultural, political, and economic elements, among others. Moreover, they are based on sociological and anthropological perspectives,

reflecting how the means of sociocultural development of the human species shape the ways of treating the environment and living beings.

Biocultural anthropology focuses on the relationships that individuals have with their environments; in this context, culture shapes the adaptive, political and behavioral forms of people (LENDE, 2013). From this perspective, bioculturalism, when associated with biological diversity, can be proposed along the lines that rural and traditional communities generally have more harmonious and respectful relationships with living beings, leading to more sustainable practices, for example.

In this approach, two opposing elements are present: integrators and disintegrators. These can indicate whether the representations of nature and living beings incorporate human practices. Responding positively to this incorporation, we say that there are integrative ideas. Positioning themselves negatively, we find conceptions that bring the separation between human kind and nature, between urban and rural environments, among other dichotomies. In his work, Diegues (2008) seeks to overcome this proposal of untouched and wild nature, defended by preservationist scholars, by arguing that the human species and its sociocultural contexts are integrated to biodiversity.

The richness of Brazilian socio-biodiversity illustrates these varied interrelations. Local traditional communities, for example, due to their ethical precepts, expressed in their beliefs and practices, are able to coexist with other living beings, in relatively high human concentrations, with minimal impact rates, and can even provide biocultural restorations (PRIMACK; RODRIGUES, 2001).

These restorations reinforce the close relationship between biological and cultural diversity, in which farming practices, for example, based on ethnoecology, favor "[...] the preservation of culture and ethnoscience, of natural agroecosystems, and of the genetic resources of local crops" (PRIMACK; RODRIGUES, 2001, p. 284, our translation). However, Toledo and Barrera-Bassols (2015) point out that these local perceptions have been labeled outdated and unfounded by the techno-scientific and economic rationality of development; the rural and its conceptions have thus become irrelevant to the vision of large-scale urban progress.

Despite the notable contributions of the biocultural perspective, we propose the essentiality of a biocentric approach, considering equity as a fundamental value of the relationship among living beings and between living beings and nature. This equitable ethic is about recognizing the uniqueness of all species and presupposes the recognition of their interspecific otherness.

The biocentric approach is designated here based on the perspective of equitable ethics. For this, we first base ourselves on the propositions of Ingold (1995), who presents the human species as just one more among the countless existing on the planet. In an anthropological thought, he defends the overcoming of the historical dichotomy between "humans and animals" to establish new relational meanings among all species on the planet, respecting the existing diversities (INGOLD, 1995).

Biocentric thinking also proposes a nature with "[...] value in itself, in an attempt to rescue the essential ethical imperative" (LEVAI, 2011, p. 12, our translation), that is, the perception of the intrinsic value of living beings encourages the change of thoughts and habits of human indifference about them and advocates the right to live and survive for all, preaching equity as a way to achieve environmental justice.

From the discussions about nature knowledge and humanity's self-knowledge and alterity relationships with other living beings, Pagan (2018, p. 75), from a biocentric perspective, which we advocate here, states that "[...] teaching about nature starting from self-knowledge and ethno-knowledge, can be much deeper and more effective for student learning." In this way, biology teacher education and science teaching can give due attention to the subject that learns and teaches at the same time, also reinforcing the need to include non-cognitive aspects of learning, such as the affective element (PAGAN, 2018).

To this end, it is essential that we seek to admit the interspecific alterities as a sustaining element of biocentrism. These reinforce that the human species is just one among many others that inhabit the planet. Despite this, it is remarkable how much we define, based on natural differences, those who have greater or lesser right to life; this is how, throughout history, we have excluded from the "highest level" of species the black community, indigenous people, women, "consumer animals", among many other groups.

Aware of the unique perspectives of all living beings, it is crucial that teachers in training have the sensitivity to perceive and understand them, so that their practices provide the inclusion of these particularities, as well as their perceptions of the world. Therefore, we point out the importance of a more humanized education for biodiversity, in the sense of recognizing the sociocultural experiences that they have with living beings, and how these practices relate to thoughts and actions towards the environment in general, recognizing equity as a fundamental value in the construction and respect for otherness involving the species that inhabit this planet, in addition to trying to solve discriminatory, authoritarian, and intolerant processes.

## **Final remarks**

In this way, we consider that individual and social characteristics can shape the ways of relating to other living beings, as long as they conform to both the consideration of social otherness among the members of our species, as well as interspecific ones, which consider a biocentric ethic in the relationship with the living world. In this context, characteristics that sometimes appear to students as traits that give them an abnormal status, in fact grant them special abilities that allow them to see the world from specific and innovative points of view. This need for a more humanizing teacher education is relevant in themes such as biological diversity, especially when combined with the environmental issue, due to the need for awareness and engagement of individuals in effective sustainable practices and the resistance of local knowledge and practices.

We also propose that the recognition of the relations between particularities/collectivities and the themes related to the variability of living beings helps in the process of social emancipation of the teacher in training, since, when entering the academic environment, he/she sees him/herself in a place that inspires the development of cognitive skills for scientific thoughts and practices.

As for the biocultural and biocentric approaches, they present efficient possibilities of approximation between biological and cultural diversity, through the analysis of individual, socio-historical and natural conformations. However, the biocentric perspective innovates by proposing equity, which, based on the recognition of the interspecific alterities of living beings, opens the way for the construction of an education that recognizes the rights of other species on the planet and provides for (re)connection, (re)integration, and diplomatic coexistence.

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### How to reference this article

SANTOS, I. M.; PAGAN, A. A. Biological and cultural diversity in biology teacher formation: Any relation? **Revista Ibero-Americana de Estudos em Educação**, Araraquara, v. 17, n. 4, p. 2664-2683, Oct./Dec. 2022. e-ISSN: 1982-5587. DOI: <https://doi.org/10.21723/riaee.v17i4.16079>

**Submitted:** 06/01/2022

**Revisions required:** 14/07/2022

**Approved:** 20/10/2022

**Published:** 30/12/2022

**Processing and publication by the Editora Ibero-Americana de Educação.**

Correction, formatting, standardization and translation.

