Recebido: 10/03/2022 ■ Aprovado: 20/07/2023 ■ Publicado: 01/10/2023

eISSN 2179-426X
10.26843/rencima.v14n4a10

Revista de Ensino de Ciências e Matemática

The teaching of biodiversity: focusing on pedagogical and assessment practices

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Abstract: In this study, we analyze the organization and the pedagogical and assessment practices of biodiversity teaching carried out by high school teachers. A qualitative method was used for data collection. The results indicated that teachers had narrow view of biodiversity, which may have implications for the organization and for teaching of biodiversity. Most teachers planned in a following way: diffuse objectives, few social implications, and no political connotation, above all, focused on the textbook and not including the appreciation and analysis of the local biota. This approach can be considered a type of technical and neutral planning that, possibly, not meet the purposes of engaging students in conservation actions. Teaching was based mainly on lectures, a type of methodology that does not involve students in everyday situations, challenges and problems related to the local biota. These findings indicated the need to review initial and continuing teacher education related to biodiversity.

Keywords: Biodiversity Teaching. High School Teachers. Planning. Class Management.

Enseñanza de la biodiversidad: en pantalla la organización y gestión de las clases

Resumen: En este estudio analizamos la organización y gestión de la enseñanza sobre biodiversidad realizada por maestros de la escuela secundaria. Se utilizó un cuestionario cualitativo para la recolección de datos. Los resultados indicaron que los profesionales tenían una visión reducida sobre el tema, lo que puede tener implicaciones para la organización y gestión de la enseñanza. Planificaban de manera muy diferente, con objetivos difusos, pocas implicaciones sociales y ninguna connotación política, centrados, sobre todo, en el libro de texto y lejos de la apreciación y análisis de la biota local. Un tipo de planificación técnica y neutra que, posiblemente, no logró los propósitos de involucrar a los jóvenes en las acciones de conservación. La gestión de la enseñanza se basó principalmente en clases magistrales, un tipo de metodología que no favorece lo involucramiento con situaciones, desafíos y problemas cotidianos relacionados con la biota local. Los hallazgos indicaron la necesidad de revisar la formación inicial y continua de los maestros en relación con el tema.

Palabras llave: Enseñanza de la Biodiversidad. Profesores de Secundaria. Planificación. La Gestión del Aula.

O ensino de biodiversidade: em tela a organização e gestão das aulas

Resumo: Neste estudo, analisamos a organização e a gestão do ensino de biodiversidade realizada por professores de Ensino Médio. Foi utilizado um questionário qualitativo para a coleta de dados. Os resultados indicaram que os

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profissionais possuíam uma visão reduzida sobre o tema, que pode ter implicações na organização e gestão do ensino. Eles planejavam de forma bem diferenciada, com objetivos difusos, poucas implicações sociais e nenhuma conotação política, centrado, sobretudo, no livro didático e distante de apreciações e análises da biota local. Um tipo de planejamento técnico e neutro que, possivelmente, não atinge os propósitos de engajar os jovens em ações de preservação. A gestão do ensino assentava-se, principalmente, em aulas expositivas, um tipo de metodologia que não favorece o envolvimento com situações, desafios e problemas cotidianos relacionados à biota local. As constatações deste estudo indicaram a necessidade de rever a formação de professores, inicial e continuada, em relação ao tema.

Palavras-chave: Ensino de Biodiversidade. Professores de Ensino Médio. Planejamento. Gestão das aulas.

1 Introduction

The concept of biodiversity is a structuring reference for the teaching of biological sciences since it allows us to understand how the various forms of life interact with the environment. It is associated with the multidimensionality of biological diversity. For Rawat and Agarvwal (2015), such diversity is distributed in three levels: in the first, there is species diversity; in the second, genetic diversity; and in the third, ecological diversity.

Garlic (2008) discussed the importance of biodiversity, based on a set of values. The intrinsic value, based on preservation and conservation; the utilitarian, based on the direct benefits of biodiversity, such as medicinal exploration, for example, and indirect, such as maintenance of air quality and climate; the aesthetic, focused on contemplation, based on ecotourism. There is also the market and the political value, centered on environmental policies, and the scientific value.

Biodiversity and its ecosystem services, such as the supply of water, food, and air, among others, are essential for building a sustainable future worldwide. Such sustainability can help reduce social and economic inequalities and influence the generation of future jobs. However, above all, the theme has generated concern with its loss, the extinction of species, and their recovery and conservation. These themes have been most highlighted after the United Nations Conference on Environment and Development, Eco-92. At this conference, the Convention on Biological Diversity (CBD) was defined, giving a guideline for policies, research, and actions on the issue.

This worrying situation related to the theme has been aggravated by the current predatory development model that destroys the environment, causing biodiversity loss and degradation of ecosystem services (*BOWLER et al.*, 2020). Such a situation has

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occurred frequently but differently in the various ecosystems worldwide. In Brazil, this loss is inserted in a crisis of socio-environmental governance, where the legal structure of environmental management has been dismantled (JOLY and QUEIROZ, 2020).

Solutions to this crisis framework should include the school's context and young people's education. In this context, biodiversity education is responsible for stimulating and developing knowledge among children and young people on ecological principles, among other issues. As indicated by Zelezny (1999), young people are more interested in preserving the environment than adults and, in understanding this, we see that basic schooling is the most appropriate time for developing attitudes, interests, and knowledge about biodiversity.

Preserving and conserving biodiversity is one of the biggest challenges today, in 2022, and this undertaking depends on knowing it. A context in which the teaching of biodiversity –especially in high school, where knowledge is even more systematized– must be assumed as part of the equation for people's development. However, as Miani (2013, p. 92) pointed out, "work on biodiversity education is still scarce".

Some researchers have been dedicated to broadening the understanding of biodiversity teaching. Some sought to understand the trends and challenges of this teaching (OROZCO MARÍN, 2017), and others as the theme has been presented in textbooks (FONSECA, 2007; MIANI, 2013), which are sources of inspiration for teaching teachers.

The teaching of biodiversity, considering the current importance of the theme and the lack of work, can represent a critical pillar to expand the knowledge and engagement of young people in actions to protect the environment. In this sense, we present data from a study in which we analyze the organization and management of biodiversity teaching developed by high school teachers.

2 The teaching of biodiversity

Biodiversity teaching is crucial for education in general, especially for the teachings of science and biology. Studying the subject is central, above all, because our existence and our quality of life depend on biodiversity. Every student must know this centrality and develop attitudes towards and knowledge of biodiversity with a view to its preservation.

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Among the justifications for the importance of teaching biodiversity, we can indicate the issue that young people must understand and discuss population growth, which generates a high contingent and high consumption of energy, resources and waste production, a situation that has caused an impact on natural systems and can generate ecological damage and the extinction of species.

Due to its complexity, the teaching of biodiversity must be a space for developing ethical, scientific, political, social and technical knowledge on the subject. In addition, it must promote the engagement of young people in practical conservation and preservation actions.

Orozco (2017) reflected on the trends and challenges of biodiversity teaching in the Brazilian context. The author identified some approaches related to the concept, the methodological approach, the didactic resources, and the difficulties pointed out in the research.

Due to its complexity and relevance today, the teaching of biodiversity must be organized comprehensively in terms of planning and didactic resources used. The teacher must manage it by using differentiated strategies and assessment forms.

However, teachers who teach biodiversity have relied heavily on textbooks. Fonseca (2007) affirms that the textbook contents do not allow teachers to have a comprehensive approach to the subject, which can be associated with other areas of knowledge and local, regional, national, and international realities. In many situations, the material also does not help promote reflections on the local reality. The author suggests that new types of materials, those that favor discussions more focused on local biodiversity, be used to favor students' formation.

2.1 The planning in question

Planning organizes and rationalizes teaching. For Libâneo (1991), it is a process of systematization and organization of the teacher's actions to rationalize the pedagogical work, articulating the school activity with the contents of the social context. It is a search for improving teaching, based on the balance between means and ends and between resources and objectives to be achieved. It is an active instrument that focuses on systematized decision-making on the curriculum, content, student, teaching, methodologies, and assessment forms, among other issues.

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Planning is situated in the organization of elements of knowledge approach, disciplinary or interdisciplinary, selection of objectives, content, methodologies, and assessment forms. In this way, its dimensions go beyond the scientific perspective, linked to technical, political[3], social, and cultural issues.

The planning of biodiversity education must be undertaken based on these dimensions. In this context, the interdisciplinary approach is fundamental to deal with the complexity and relationship of the theme with ethical, social, economic, and political challenges, among others (VINCENT, 2011).

The relationships of biodiversity education planning with the community are essential for studying the theme from the local biota, unlike textbooks that do not favor the contextualization of actual and current problems. Indeed, this teaching cannot be dissociated from other social and local problems, being only about concepts approached in a non-contextualized way.

2.2 The centrality of didactic resources

We understand didactic resources as all types of material teachers use to direct and monitor the teaching and learning process, from the most traditional, such as textbooks, blackboard, and chalk, among others, to the most modern ones: computers and applications (SOUZA, 2007).

As a complex and integrated knowledge from various areas, biodiversity teaching enables using different resources, promoting new experiences and learning. However, we observe that students' learning depends mainly on the teacher's mediation.

Orozco (2017) found various materials, tools, and didactic resources that helped biodiversity teaching. The author classified them as: "natural and contextual resources, contemporary resources, dynamizing resources, laboratory resources and traditional technical resources" (p. 182).

The textbook is among the resources used in the teaching of biodiversity, especially in high school. However, we realize that this material does not always contextualize knowledge; it does not use everyday problems (FONSECA, 2007). This author also indicated that many textbooks present content in a way that contributes

[3]Here we do not refer to party politics, but rather education as a political act from the Freirian perspective.

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little to the full understanding of local biodiversity, besides impairing a critical view of it.

It is noteworthy that teachers can study biodiversity from the context of their schools, using magnifying glasses to appreciate insects, leaves, and microorganisms, among others.

2.3 Active teaching strategies

According to the 2018 Teaching and Learning International Survey (TALIS) (2018), teaching is usually based on expository classes in Brazil. For Masetto (2010, p. 79), this teaching strategy is used in 95% of classes. This author argues that such trend occurs due to the fragmentation of time in schools (50-minute classes) and content.

Several scholars have criticized the expository class as the main didactic resource used in classes. For Anastasiou (2009), in this type of technique, the teacher explains while students writes down the information passively. For Frota-Pessoa, Gevertz and Da Silva (1970, p. 45), this method favors the development of the teacher –who actively reflects on the subject– instead of the students. Bordenave and Pereira (2008) also indicated that teachers use this technique because their teaching repertoires are small.

Despite the validity of the lecture, in some cases within the field of teaching, the student has a generally passive attitude, in this type of strategy. There is also the issue that some teachers use the blackboard to “transfer” the content, “wasting” time and allowing young people to divert by using their mobiles and the like.

In this class type, the student is limited to the teacher’s explanations, provoking, according to Lopes (2011, p. 43), some “students’ feeling of comfort or passivity. They limit themselves to absorbing everything that the teacher says”.

In another bias, active learning methodologies, which originate from John Dewey, among other educators, consider the student the central protagonist of their learning and teachers as mediators of the process. This type of strategy develops skills associated with initiative and creativity, reflection, cooperation and responsibility, among other issues.

Active methodologies include, for example, flipped classes and project-based and problem-based learning. It is last known by the acronym PBL (Project Based

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Learning). It aims to lead students to learn based on the collaborative resolution of challenges and problems, promoting the search for solutions within a specific developing context, which can rely on different resources and technologies (LOVATO *et al*., 2019).

Problem-based learning suits biodiversity teaching well due to its characteristics. It can enable learning contextualized knowledge inserted in local biodiversity problem situations. To Orozco (2017, p 184), active methodologies "related to the approach to local biodiversity problems", among others, are appropriate approaches to guide the pedagogical practices of biodiversity teaching.

2.4 Through a comprehensive assessment process

In the learning assessment, as an act of investigation of the quality of reality, phenomenon or object, it is necessary to define the objective assessment in which a description will be carried out, the data collection instruments, and the quality criteria to be compared with the description (LUCKEZI, 2018). According to Lukas Mujika and Santiago Etxeberria (2009, p. 91-92),

> Assessment is the process of identification, survey, and analysis of relevant information of an educational object –which can be quantitative or qualitative– in a systematic, rigorous, planned, directed, objective, credible, reliable, and valid way, to issue value judgment based on pre-established criteria and references to determine the value and merit of this object in order to make decisions that help optimize it.

Teachers have used various instruments for data collection, such as seminars, questionnaires, observation, research, portfolios, and tests. It is noteworthy, however, that the test has been the most used instrument, either by interest, lack of training for the use of other means, or by the school's regimental force.

The test emerged to attribute a more objective, quantifiable, and scientific specificity in collecting information about what the student knows about a given subject. It constitutes "the most 'objective' and adequate way to measure learning outcomes by their intended reliability and the possibility of quantifying results" (QUINQUER, 2003, p. 24).

Despite the validity of the test in a formative perspective to assist students in overcoming obstacles, as Moares (2011) indicates, many teachers use these instruments to evaluate the "mechanically learned contents. They assign grades

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thinking that they reflect –without deviation– the student's learning. They do not analyze, do not weave considerations, or carry out deliberation. They only correct, assign grades and classify students" (MORAES, 2008, p. 63).

This mechanical process that involves classification and, in many cases, exclusion, according to Villas Boas (2007), can generate inappropriate consequences, such as favoring the construction of a negative self-image, especially during childhood, which may last until adulthood. It can also "cause disapproval and repetition, resulting in more years of studies than expected [...]; force the student to escape. All this represents a failure in a person's life and has a very high price (VILLAS BOAS, 2007, p. 52).

In this context, it remains open whether, in fact, the proof has the potential, as the main instrument, sometimes unique, to evaluate knowledge related to biodiversity, considering its complexity, its relations with other areas of human knowledge and its implications associated with the social, political, economic and scientific field, among others.

Testing through active methodologies may be irrelevant to the assessment process. In problem-based learning, for example, assessment uses various data collection instruments, has a diagnostic and formative function, and serves students' learning.

3 Methodology

In this study, part of a larger project funded by the Fundação de Amparo à Pesquisa do Estado de São Paulo (Fapesp), we analyze the processes of organization and management of biodiversity education developed by teachers who work or worked in high school.

We used a qualitative research approach to respond to the study's objective. According to Minayo (2002, p. 21-22), this type of methodology seeks to answer particular questions, working with the "universe of meaning, motives, aspirations, beliefs, values and attitudes, which corresponds to a deeper space of relationships, processes and phenomena that cannot be reduced to the operationalization of variables". This research aims to understand the subjective meanings of the organization and management of biodiversity education.

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For the research, we invited 94 teachers, of which only 26 from several municipalities in the state of São Paulo, and a small group of other states, agreed to participate. The participants were from São Paulo (35%), capital, Santo André, São Bernardo do Campo and Diadema (12%), Bertioga, Piracicaba, Jundiaí, Guarulhos and Capivari (6%), and a small group was from other states: Paraná, Rio Grande do Sul, and Macapá.

For data collection, we used a qualitative questionnaire to study diversity, not population distribution. To Jansen (2012), this type of instrument assists the researcher in interpreting the diversity of the subjectivities of the participants instead of the analysis of the relationships between the variables. It is usually used for the exploration of meaning and experiences.

The questionnaire collected information about the participants' profiles: gender, age, marital status, place of residence, initial and continuing education, the level of education they teach, teaching time, and weekly workload. Information was also collected on: a) the organization of biodiversity teaching, based on the importance that the teacher attributes to the theme, on the ways of planning and selecting didactic resources to be used in classes; b) the management of teaching based on the strategies used by teachers in classes, on the ways of carrying out extra-class activities and evaluation. Table 1 illustrates some categories and questions of the questionnaire:

Table 1: Information on the questionnaire

Personal Information	**Education information**	**Job Information**	**Information on the organization and management of biodiversity education**
Closed questions			**Open questions**
Gender	Initial education	Teaching time	How important is biodiversity?
Age	Institution type	Teaching time in high school	How is biodiversity content planning carried out?
—	—	—	Is there any differentiation attributed to the biodiversity theme in the planning?
Marital status	Course format	Acting time at school	How is the selection of biodiversity-related content carried out to be worked with students?
Housing	Continuing education	Workload	What materials, books, and websites are used to prepare and use in biodiversity classes?
—	—	Level of education they taught	What types of extra-class activities are performed by teachers?

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—	—	—	How is biodiversity-related content addressed in classes? By what teaching strategies?
—	—	—	How is biodiversity content assessed?

Source: Own Authorship (2022).

In order to answer the questionnaire regarding the organization and management of biodiversity teaching, teachers were asked to reflect on their answers before the Covid-19 pandemic, in other words, when classes were held in person.

Data analysis involved the approach of grounded theory (CRESWELL, 2002). In this sense, we sought to extract the most significant aspects of the answers based on teachers' experiences teaching biodiversity.

Initially, the data were analyzed with a thematic reading of the statements. The main themes were grouped, and then, codes and descriptors were used to filter the information and sinter the results. The syntheses made it possible to create the study categories.

4 Results and Discussion

The results are presented, first, from the profile of the participants, after which they reveal the process of organization and management of biodiversity teaching from a group of teachers' perspective. Table 2 presents the profile data:

Table 2: Profile data of teachers who participated in the study

Category	Data	
Gender	Female (85%)	
Average age	40 years old	
Marital status	Single (43%)	Married (31%)
Initial education	Public university (70%)	
Format	Face-to-face (85%)	
Postgraduation	Some postgraduation activity (81%)	
Teaching time	Less than five years (40%)	Over 20 years (20%)
General workload	They worked more than 30 hours a week – (54%)	
Grade level	They worked in high school in the year of the research (90%)	
Workplace	Public schools (100%)	

* Rounded data; Source: Own Preparation

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Of the participants, approximately 85% were female, 40 years old on average, and a standard deviation of 12.02. Most professionals were graduated from public universities in biology, biological sciences or with a degree in sciences with a specialization in biology. These professionals had some type of postgraduation, had already taught high school classes, and have worked in public schools for more than 30 hours a week.

4.1 The organization of biodiversity education

The organization of any teaching is influenced, among other issues, by the importance teachers attribute to it, how planning is done, and how didactic resources are selected to be used in classes.

Regarding importance, all teachers who participated in this study, without exception, stressed its relevance, which can be grouped into some categories already developed by Alho (2008): intrinsic (preservation and conservation), scientific (scientific knowledge), policy (public policies), and utilitarian (benefits for humans).

Regarding preservation, we highlight some teachers' testimonies. One of them indicated that "The theme is important to stimulate the conservation of biomes" (P7), and another said, "Biodiversity is important for the maintenance of life; hence it is essential to work on this theme" (P2). Another professional stated, "The theme is super relevant, mainly the preservation of biodiversity, which is at risk even for future generations" (P17).

The importance of the theme was also highlighted when a professional indicated that biodiversity is "fundamental because it refers us to the balance of life" (P16), or when it is "the life of the planet, without it we also end" (P18), or even that it is the "support for life, without it, the world as we know it would not exist" (P10).

Finally, two teachers indicated that the theme is of great importance "because when we are talking about biodiversity, we are referring directly to the balance of our planet" (P8) and also because it is essential for the "maintenance of balance and stability of ecosystems" (P15).

The importance of this "spirit" of preservation and conservation of teachers indicates the understanding that the natural resources of biodiversity have limits. According to Dourojeanni and Padua (2001), there is a certain understanding that the moment is decisive for the preservation of biodiversity. In this sense, there is a need

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for a “valuation” of biodiversity to maintain the capacity of ecosystems. This situation places school as an “instrument” to assist in developing a more sustainable and fair world by teaching biodiversity.

In a study with elementary school teachers, Moreira and his collaborators (2016) showed that teachers considered the theme of biodiversity essential and, in this sense, that some teachers valued the function of each living being in nature, while others placed more human being as part of biodiversity, showing the need to preserve the environment.

A group of professionals highlighted the importance of biodiversity linked to scientific knowledge. One teacher pointed out that it is “fundamental for understanding the contents and students’ scientific and social formation” (P14). Another teacher commented that “biodiversity is extremely important for understanding ecological and evolutionary concepts” (P3). For another professional, it is relevant “to understand all the species we live with” (P1).

According to P6, “Biodiversity represents and relates to the different areas of biology. Understanding the importance of biodiversity directs the planning of actions to raise awareness of the theme”. Three other professionals also highlighted the importance of the topic. For one of them, it is “fundamental so that one can understand the cycle of life” (P12). Another one states that “with the theme, we can explain the place of the human being in the middle of all the rest of the world, showing its contributions and its defects as a rational being”(P4) and, finally, for another, its relevance occurs “because of the entrance exam” (P4).

For this group of professionals, knowledge about biodiversity is relevant, which meets the signaling of Palmberg *et al.* (2015). These researchers indicated that such knowledge is fundamental to promoting biodiversity preservation and maintaining students’ interest in nature conservation actions, which has remained elevated since 2007 (Franzolin, Garcia, and Bizzo, 2020).

Regarding the political category, only one professor stressed that biodiversity is “significant, especially since we are at a time when current public policies relegate this theme” (P20). Although only one professional signaled this fact, Joly and Queiroz (2020) had already indicated that this abandonment is part of a socio-environmental governance crisis, which is incensed “by the dismantling of the entire legal and institutional framework responsible for environmental governance, and the

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deactivation of the mechanisms that regulated the state's institutional relations with the country's traditional populations" (p. 68).

Finally, regarding the utilitarian importance of biodiversity, one of the teachers indicated that it is relevant because we can "find substances that may be necessary for our subsistence as well as other living beings" (P15). Another professional pointed out that she offers us "clothing, food, medicines, etc." (P8)

In fact, as Joly and Bolzani (2017) indicated, biodiversity can be considered, among other issues, a large pharmacy with terrestrial or marine sources. In this scenario, more than 40% of all medicines that are produced originate from biodiversity. Almost 80,000 plants are used to develop medicines for humanity (RAJESWARA *et al.,* 2012).

In the second case, in the question of carrying out the planning, we observed, in general, that the teachers planned quite differently. One teacher had an approach in which he made a preliminary plan. After a while, he conducted "a survey of the students on the subject" to evaluate them and finally finalized the final document for an entire semester (P13). Indeed, one must know students' background knowledge of the subject based on the consolidation of survey data. Indicators have revealed that young people have insufficient knowledge about the subject at the end of basic schooling (Franzolin, Garcia, and Bizzo, 2020; Zanini *et al.*, 2020).

Data from the survey are also important because they enable the elaboration of a plan to meet the various levels of knowledge about biodiversity. For Luckezi (2018), the diagnostic use of students' results subsidizes possibilities of intervention in reality so that young people reach the desired quality standard. It allows us to understand the situation in terms of learning the contents and giving them new directions.

Three teachers carried out their planning using the school's curriculum (P11, P14 and P20), and others used the curricular references of the National Common Curricular Base (P9 and P21). To plan, some professionals selected videos, music, and images from the internet (P10) about the theme; others chose films (P11 and P26) with explanations on the subject or used complementary activities (P21), exercises.

Some teachers planned to select scientific dissemination articles (P3). One teacher was looking for "themes that are recurrent in the student's daily life, that are part of the entrance exam and that connect with other areas of biology" (P4). Some

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professionals sought content from books for theoretical and practical classes (P15 and P17) and lectures (P11).

A group of professionals planned to associate biodiversity content with other subjects (P5, P6, and P19) or with other areas, such as “ecology and interactions between living beings” (P2). Others planned to address the theme in an interdisciplinary (P7), transversal (P23) or inserting the theme in projects (P22).

Only P7 said that “biodiversity is treated in an interdisciplinary way with history and geography”, based on the integration of knowledge, which is relevant given the characteristics of the theme. As indicated by Vincent (2011), interdisciplinary approaches should focus on the environment and disciplines but, in addition, establish a methodological communication between them, unifying the process as a whole in schools through integrative programs that account for the complexity and interconnection of the various components of the global ecosystem. Indeed, biodiversity teaching requires overcoming a merely disciplinary approach that, in general, is characterized by the fragmentation of knowledge. An interdisciplinary approach to knowledge is needed so that complex ethical, environmental, social, scientific, economic and political challenges are understood and addressed.

Despite the breadth and variability of ways of planning, it is noteworthy that few teachers included the study of local biodiversity in their planning, albeit superficially. One professional stated that he was “concerned with the selection of images of species from the region in which I teach, the local biome and other Brazilian biomes respectively and, if possible, visitation to the municipality’s butterfly centre” (P3). Another teacher was looking for “local examples of relationship and biodiversity.” At the same time, he identified “locations and also worked on the relationships that generate interest in students, using excerpts from films or documentaries”. Finally, another teacher aimed to “approach the theme and adapt to the aspects of my students’ experiences, as we are in the state of São Paulo, I end up addressing and giving greater emphasis to the animal and plant characteristics found here” (P12).

This absence of the study of local biodiversity can perhaps be explained by the lack of training or by the fact that biology curricula in Brazil tend to favor the study of large charismatic specimens of exotic megafauna (e.g. polar bears, elephants, giraffes, penguins, etc.) native to other regions instead of encouraging the study of local animals (OLIVEIRA and COOK, 2019). These same authors indicated that the study of

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biodiversity should focus on insects found in the backyards of young people's homes. That is, the local biota.

Regarding planning organization, most teachers did not differentiate teaching on biodiversity from others in biology. One professional indicated that "the theme is studied concomitantly with other subjects, nothing very specific" (P20). To this teacher, the subject has been addressed "along with several other types of content, such as when we study living beings as a whole and end up addressing biodiversity. Also, when we study environmental problems, we mention the topic."

On teacher (P19) sought to differentiate teaching from planning based on inserting various themes, including Evolution and Ecology content. To another teacher (P4), the basis was in the curriculum with the prioritization of "topics that cover other areas of biology to facilitate the compression of the subject." We observe that the topic, despite its importance in the current context due to the degradation of ecosystem services and their loss (BOWLER *et al*., 2020; JOLY and QUEIROZ, 2020), or its socio-environmental governance crisis (JOLY and QUEIROZ, 2020), has not been treated differently in biology planning.

In the third case, of the selection of resources to be used for teaching biodiversity, some teachers searched blogs and websites, such as *Science Today* (P26); others selected materials on *Youtube* (P1, P11, P12, and P13) or Google (P12 and P17), or platforms such as *Khan Academy* (P21). Other professionals preferred to choose scientific articles to use in classes (P6 and P19).

Some professionals indicated selecting newspaper reports (P6), films and documentaries that deal with the theme of biodiversity (P2), or the curriculum itself and the National Common Curricular Base (P9).

One techar stated that he selected materials from the site of the Instituto Chico Mendes de Conservação da Biodiversidade do Ministério do Meio Ambiente — ICMBIO (P24) for the teaching of biodiversity.

In this context, about 60% of teachers said they select and use as their main resource the textbook to teach biodiversity, often in conjunction with other materials. One teacher said he used a textbook "of science and biology from Brazil's publisher and the student's notebook." He looked for "digital courses on the site of the planet bio,

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I look for documentaries, lesson plans and other didactic resources on the site digital school to inspire me or even use directly with the classes" (P4).

The use of the textbook as the only resource is a finding that deserves further reflection since, as indicated by Fonseca (2007), using this material has not enabled the contextualization of knowledge based on actual and current problems. This material may even, in some situations where it is requested to memorize the content, limit young people's learning.

Various research on this material has shown little use of the local biota approach compared to faunas from other countries. Silva (2016) indicated that images of exotic fauna in textbooks for teaching biodiversity are frequent, although there are guidelines and recommendations to the contrary. Seventy per cent (70%) of the books analyzed by this author did not suggest practical activity regarding the study of local fauna or flora.

4.2 The management of biodiversity education

We analyzed teachers' strategies, including the extra-class activities and the assessment forms, to investigate the management of biodiversity teaching. Table 3 presents the following teaching strategies:

Table 3: Teaching strategies used by the teachers who participated in the study

TEACHING STRATEGY	Teachers
Expository lectures	1, 2, 3, 4, 10, 11, 15, 20, 25, 26.
Video usage	1, 9, 14, 20, 22, 24.
Seminars	2, 8, 13, 26.
Field visits	2, 6
Reading articles and texts	9, 10.
Discussions	6, 8, 17.
Research on related topics to biodiversity	6, 11, 15, 23.
Laboratory activity	6, 13, 15, 25, 26.
Flipped class	7, 8, 9.
Use of slides	10, 22, 24.
Internet use	10, 12, 14.
Case study	15.

Source: Own elaboration, 2022

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The strategies used for the teaching of biodiversity were varied. However, expository classes still predominated in this teaching. This pedagogical practice may be more associated with students' inaction in the face of the construction of knowledge.

For Meyers and Jones (1993), some teachers believe that students attending an expository class are actively involved. Nevertheless, the authors showed that, to learn, young people must do something more than just listen. To Anastasiou (2009), a lecture is a situation where the teacher explains the content, and the student, inserted in this context, must write down the information and memorize it. This scenario often does not require the student's presence, as another student can copy and hand the content to them.

As indicated by Frota-Pessoa, Gevertz, and Da Silva (1970, p. 45),

> The traditional method of teaching is of extraordinary efficiency to develop the teacher because they are the ones who perform the acts that lead to the training objectives, whereas the students are subjected to exposure classes that do not give them development opportunities.

Teachers use expository classes because "they have very few techniques in their didactic repertoire" (BORDENAVE and PEREIRA, 2008, p. 122). However, biodiversity education requires an active approach to studying local biodiversity. They are methodologies that involve learning by projects or by problems.

A few teachers, however, use flipped class and case study, approaches that can be considered active, as they challenge young people to perform complex mental tasks related, for example, to analysis, synthesis, and assessment (LOVATO *et al.,* 2018). Such methodologies induce students to be more interested in classes due to curiosity about everyday situations, enabling discoveries based on what is already known. A context in which the teacher, according to Masetto (2003), plays a co-responsible role, planning with young people and seeking strategies that promote participation.

As for extra-class activities, such as teaching and learning strategy, were rare and episodic. Few teachers took students to visits to museums or botanical gardens (P2 and P13), conservation areas (P2) or promoted some kind of technical visit (P10) or some form of study of the environment (P6 and P15). In general, they occurred circumstantially, sometimes once a year.

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One teacher organized visits “to museums, botanical garden, zoo, biological institute” (P2). Another stated that “whenever possible, we visit the Cantareira system, Cobasi store, etc.” (P10). Another professional indicated that he made “visits to conservation areas of the municipality” (P24). In the data on the extra class activities, we observed the possibility of studying local biodiversity, which appears with an episodic and non-systematized and permanent meaning, which may originate in the training of teachers in the curricular indications (OLIVEIRA and COOK, 2019), including those derived from the National High School Examination (Exame Nacional do Ensino Médio - ENEM).

Regarding the data collection instruments to qualify students for learning, all teachers used some type of test. It was the school’s regimental test. However, other professionals used a second test and other instruments. Table 4 summarizes the data:

Table 4: Data collection instruments used by teachers.

Shapes	Teachers
Some type of exam	1, 2, 4, 5,10, 11, 15, 20, 23, 25, 26.
Some kind of work (Individual or Group)	1, 4, 5, 7, 10, 15, 17, 22, 26.
Material Yield	14.
Participation and involvement in the activites	2, 3, 4, 8, 13, 14, 21, 24, 26.
Activity in the student notebook	4.
Seminars	3, 4, 24.
Daily practical observations and activities	2, 25
Exercises	1, 4, 26.

Source: Own elaboration, 2022

We can see that teachers used several data collection instruments. Among them, those involving cognitive and non-cognitive aspects. The students:

> *they are evaluated with the participation and interaction in the class, construction of mental maps, evaluations, activities of the student’s notebook, list of exercises and some other work (seminar, video of some practical activity) that I request during the bimester (P4).*

We can also observe that this professional (P4) used several elements to evaluate young people: some cognitive, such as tests, and others non-cognitive, such as participation and interaction in class.

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One professional (P10) indicated that he used tests “with objective and/or dissertative questions”. For another teacher, the test was carried out in a “written form with the other types of content, with some specific questions” (P20). The use of the test, in addition to the problems that this instrument can cause in collecting information to evaluate students (MORAES, 2011; VILLAS BOAS, 2007), is believed not to have the potential to evaluate young people in biodiversity content.

To assess biodiversity education, we must use a set of instruments due to the complexity and characteristics of the subject. It may include evidence, of course, but, for example, observation is key to analyzing young people’s learning in action by studying the local biota.

5 Final Considerations

When we carried out an analysis of the processes of organization and management of biodiversity teaching developed by teachers who work or worked in high school, empirical evidence came to light, enabling the construction of a preliminary framework on the subject.

The professionals who participated in this research highlighted the importance of biodiversity, especially concerning preservation and conservation and for studying its scientific knowledge. This situation demonstrates a partial view of the relevance of the theme, which may have implications for planning and selecting resources for classes. It can also have consequences for education management, including the strategies used to teach and the tools used to assess young people.

They planned in a well-differentiated way, with diffuse objectives, few social implications and no political connotation, centered, above all, on the textbook and distant from appraisals and analyses of the local biota. A type of technical and neutral planning that possibly does not achieve the purpose of engaging young people in preservation acts.

The management of biodiversity education was also carried out in a very varied way, but it was based mainly on lectures and the use of the test as the fundamental element for the assessment. Nevertheless, the value of the strategy used to collect data on students’ knowledge, the test, does not favor students’ participation and involvement with situations, challenges, and daily life problems related to the local biota, nor does it help assess the quality of young people’s learning.

The findings of this study on the organization and management of biodiversity education indicate that it is necessary to review the initial and continuing teacher education regarding biodiversity teaching. This training should focus, among other issues, on organizing and managing teaching on such a trendy topic today.

Acknowledgements

Fundação de Amparo à Pesquisa do Estado de São Paulo — Projeto Regular, Process number 2019/14210-3. Thematic Project, Process number 2016/05843-4.

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