The concept of species under debate: reflections and perceptions of undergraduate students in Biological Sciences

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Abstract
This study aimed to explore the perceptions of undergraduate students in an initial teacher training program in Biological Sciences regarding the concept of species. It employed a qualitative action-research approach involving 25 first-semester students from the Federal University of Pará, Marajó-Soure campus, who were enrolled in an Ecology course from May to June 2024. Although most participants claimed to be familiar with the concept of species, only 12% were able to provide coherent explanations, revealing a gap between perceived knowledge and actual conceptual understanding. Students also recognized that using teaching resources makes learning more engaging and helps bridge the gap between theory and practice. It is therefore suggested that exposure to diverse instructional tools can enhance teaching practices and support the learning process.
Keywords
teaching and learning; Biology teaching; initial training; didactic resources.

O conceito de espécie em debate: reflexões e percepções de estudantes da licenciatura em Ciências Biológicas

Resumo
O objetivo principal foi discutir sobre a percepção que discentes do curso de formação inicial em licenciatura em Ciências Biológicas têm a respeito do conceito de espécie. A pesquisa é do tipo pesquisa-ação, com caráter qualitativo, e contou com a participação de 25 discentes do primeiro semestre do referido curso da Universidade Federal do Pará, *campus* Marajó-Soure, que cursavam a disciplina Ecologia no período de maio a junho de 2024. Verificou-se que, embora a maioria dos participantes tenha afirmado conhecer o conceito de espécie, apenas 12% conseguiram expressar respostas coerentes a respeito deste. Isso explicita o distanciamento existente entre o que os discentes entendem por “conhecer” e a capacidade de escrita e explicação do conceito. Além disso, os discentes percebem que o uso de recursos didáticos é lúdico e estimulante e reduz a distância entre a teoria e a prática. Acredita-se, portanto, que o contato com recursos didáticos diversificados pode contribuir para a diversificação da prática docente e para o processo de ensino e aprendizagem.

Palavras-chave

ensino e aprendizagem; ensino de Biologia; formação inicial; recursos didáticos.

El concepto de especie en debate: reflexiones y percepciones de estudiantes de licenciatura en Ciencias Biológicas

Resumen
El objetivo principal fue discutir la percepción que los estudiantes del curso de formación inicial en la licenciatura en Ciencias Biológicas tienen sobre el concepto de especie. La investigación, de tipo investigación-acción y de carácter cualitativo, contó con la participación de 25 estudiantes del primer semestre de dicho curso en la Universidad Federal de Pará, campus Marajó-Soure, quienes cursaban la asignatura Ecología entre mayo y junio de 2024. Se observó que, aunque la mayoría de los participantes afirmaba conocer el concepto de especie, solo un 12% logró expresar respuestas coherentes al respecto. Esto evidencia la brecha entre lo que los estudiantes entienden por “conocer” y su capacidad de escribir y explicar el concepto. Además, los estudiantes perciben que el uso de recursos didácticos es lúdico y estimulante, lo que contribuye a reducir la distancia entre la teoría y la práctica. Se considera, por tanto, que el contacto con recursos didácticos diversificados puede contribuir a la diversificación de la práctica docente y al proceso de enseñanza y aprendizaje.

Palabras clave
enseñanza y aprendizaje; enseñanza de Biología; initial training; didactic resources.

1 Introduction

Biology teaching today involves a series of relationships and complexities that range from factors associated with technological development to those related to the experiences and cultural history of the subjects in learning. In this context, the teaching of Biology considers science, society, technology and the environment as dimensions that are closely related, increasing the challenge of teaching practice in the process of teaching and learning typical concepts of the biological area.

Longo (2007) reflects that, from the nineteenth century, when technology began to use scientific knowledge in order to innovate and develop, teaching and learning in Biology became an even greater challenge, since biological concepts finally come to be understood in their complexity and comprehensiveness in terms of applicability, that is, the various interdisciplinary and transdisciplinary relationships of which Biology is constituted are understood, reducing the view that science is applied only to the search for new discoveries, expanding knowledge about the connections of Biology with Chemistry, Physics, Engineering, the Humanities, among other areas.

With the impetus to transform this challenge into an opportunity for the development and expansion of biological knowledge, Alffonso (2019) understands that, amid the great dissemination and use of technological resources in society, the Biology teacher has the task of seeking stimulating ways for the teaching and learning process in Sciences and Biology, without distancing himself from society's desires for new technological discoveries, nor making excessive use of traditional didactic resources.

In this sense, initial teacher education reaches a certain degree of complexity by envisioning the need to balance the teaching of important and necessary concepts for the understanding of the study area, in addition to the insertion of didactic resources that consider technological aspects and are capable of arousing the attention and interest of students of the most varied levels and modalities of teaching. Corroborating this idea, Soares and Baiotto (2015) point out that teachers can count on the development and application of differentiated activities, such as games, dynamics, field classes, practical activities, technological resources, software, among others.

In turn, Andrade, Silva and Araújo (2024) warn that we live in a social moment in which it is increasingly required that we develop various skills in the face of conflicting situations and socio-environmental problems that the world has faced in recent decades. Thus, it is important that teaching practice directs teaching and learning activities to situations that contribute to the construction and proposition of diversified didactic-pedagogical methodologies and practices in the teaching of Biology, associating the technological innovations inherent in the current century to the needs and different realities of students.

The didactic resources that teachers use in the classroom can be understood as educational instruments capable of assisting teachers in the didactic transposition of content, that is, in the better understanding and application of the concepts studied by students (Menezes *et al*., 2024). This need occurs in practically all areas of Biology, especially in Ecology, since this area can contribute to increasing the participation of individuals in debates and reflections on social, environmental and biological knowledge issues as a whole, being part of the daily lives of the population, although it is not fully perceived by most people and students (Almeida; Araújo; Silva, 2023).

To better understand the fields of research in Ecology, the concept of species is the core necessary for other concepts and relationships to be established in this broad area. In this sense, Silva (2019) points out that the concept of species has great relevance because it is the center of the systematization of the diversity of living beings that make up the planet. This implies the need for the teaching of this concept to be composed of didactic-pedagogical strategies that enable the development of logical thoughts and reflections, capable of arousing interest in the classification, comparison and elaboration of systems representative of the diversity of living beings, and not just the memorization of a biological classification already established and made available to the scientific community and people in general.

Bastos (1992) warns that, from a pedagogical point of view, interpretations and understandings related to the concept of species go through students' alternative formulations, that is, it is essential that students are able to understand and glimpse the applicability of this concept so that they can then understand all its scope and complexity. For this, pedagogical practice must be oriented, from the planning of classes, to a didactic-pedagogical action that takes into account the students' perceptions of the concept of species, confronting the knowledge of these students, through their life trajectories, with scientific knowledge.

From this perspective, the question is: how do the students of the initial undergraduate degree in Biological Sciences understand, perceive and/or understand the applicability of the concept of species? Do students understand the importance of using diverse methodological resources that will assist in the process of teaching and learning biological concepts, such as the concept of species? Based on these questions, it is noteworthy that the choice of the concept of species as a motto for the discussion of the origin and applications of scientific concepts is considered by Rôças, Monteiro and Siqueira-Batista (2008), a key strategy in the context of Biology teaching, as it favors an effective and significant debate on the diversity of species in the classroom.

At this point, we draw attention to the fact that one of the most widespread species concepts worldwide and widely used didactically in the teaching and learning process is the ecological (biological) concept, which considers that species are groups of organisms (populations) capable of interacting reproductively with each other, that is,

they reproduce in isolation from other species and are capable of generating fertile descendants (Mayr, 1957). Thus, although it is important to know other concepts, since a single concept of species is not capable of covering the entire complexity of existing living beings, it is valid to consider that starting from a relatively simple concept of understanding can be an effective pedagogical strategy. This may reflect on the process of understanding other concepts and the perception of relationships with other biological areas, such as the biological evolution of living beings (Silva; Meglhioratti, 2020).

In view of the problems and context presented, the present study aimed to discuss the perception that students of the initial training course in a degree in Biological Sciences have about the concept of species and how these future teachers understand the importance of the use of practical and diversified didactic-methodological resources in the teaching and learning process of this concept.

2 Methodological paths

The research is action research, as it presents characteristics such as the collection and analysis of data and the performance of planned and systematized actions and for being engaged in the investigation of problem questions related to the teaching practice commonly experienced in the classroom (Engel, 2000). In addition, the study has a qualitative character, as it proposes to investigate a phenomenon of subjective complexity, prioritizing the description of actions, the understanding of perceptions and the explanation of relationships and measurements that may arise from the research developed (Gerhardt; Silveira, 2009).

The study included the participation of 25 students from the Biological Sciences degree course at the Federal University of Pará (UFPA), Marajó-Soure *campus*, and was developed in the discipline of General Ecology. The subject is part of the curriculum of the degree course in Biological Sciences and has a total workload of 68 hours, distributed in 15 meetings, having been held between May and June 2024 for records of this research.

The course is offered in a four-year curricular flow, in which the discipline General Ecology is always offered in the first semester and guides, in its syllabus, the study of: the

physical environment and ecological principles; the Ecology of populations; the Introduction to the Ecology of communities; in addition to the elaboration of didactic material for the teaching of Ecology. Based on this guidance, a class was developed with the theme “Wealth and abundance of species: concepts and applications”. The class was divided into two moments: I – theoretical-expository approach on the theoretical concepts and applications of the theme; and II – collective production (in teams) of didactic material focused on the conceptualization of species.

Regarding the production of teaching materials, a package containing beads of various colors, shapes and sizes was made available to each team. In addition, the teams received guidance that, from this material, they should elaborate a concept of species and carry out the practical demonstration of this concept with the beads they had in hand. Students were also instructed to include the conceptual and demonstrative approach to the concepts of “richness” and “abundance” of species, indicating the number of different species (richness) and the number of individuals of the same species (abundance) based on the available material.

As a method of data collection, a questionnaire was constructed and made available to students in order to verify: I) the students' perception of the concept of species before class; II) the learning that occurred throughout the class and the development of the practical activity; and III) students' understanding of the importance of a didactic-pedagogical material aimed at the practical demonstration of the concept of species in the teaching and learning process.

We emphasize that the questionnaire made available to students was prepared on the Survio digital platform (www.survio.com), as it is a platform that allows access without the need for prior registration and, mainly, for allowing participants to answer the questionnaire through the WhatsApp messaging application, facilitating access and effective participation of the class. The questionnaire consisted of seven questions, with options for discursive answers (Table 1). Questions 1, 2 and 3 were made available before the proposed class, while questions 4, 5, 6 and 7 were made available only after the class was held.

Table 1 – Questionnaire applied in the development of the research

Question order in quiz	Questions that made up the questionnaire applied
1	Did you already know the terms species richness and abundance? What do they mean?
2	Did you already know about the importance of species richness and abundance in Ecology? What did you know about it?
3	Do you believe that classes that make use of practical didactic resources help in understanding the various themes and concepts that make up Biology?
4	After the theoretical class on species richness and abundance, can you better explain the meaning of these terms?
5	Did the practice carried out in the class facilitate/reinforce the understanding of the concepts studied in the theory? How?
6	In your opinion, does the use of practical teaching resources contribute to the teaching of Science and Biology?
7	Would you, as a future teacher, use any didactic resource similar to the one used to work on the concept of species?

Source: Prepared by the authors (2024)

The answers obtained with the questionnaire were organized and interpreted in the light of Bardin's (2016) content analysis, following the following phases: a) a floating reading of the answers obtained; b) construction of a textual *corpus* highlighting the representativeness and homogeneity of the terms present in the answers; c) preparation of the material; and d) exploration of the material, with the formation of categories. In addition, for some questions, the answers were expressed using Excel *software*, version 2010, through representative graphs.

Regarding the ethical aspects adopted to carry out the research, we highlight that the study is part of a broader project that seeks to investigate general and broad aspects of Science and Biology teaching in the context of initial teacher education in the area. Thus, it is worth mentioning that the project was submitted and approved by a Research Ethics Committee, through the Brazil Platform, with Opinion No. 5.327.250 and Certificate of Presentation of Ethical Appreciation (CAAE) No. 54129421.2.0000.5537, complying with the requirements of Resolution No. 510/2016. In addition, the study participants signed an Informed Consent Form (ICF) authorizing and becoming aware of the objectives and purposes of the research.

3 Results and Discussion

It is important to note that the participants were enthusiastic and interested in carrying out the proposed activity, viewing it as a practical challenge to be faced. However, a difficulty arose early on: what criteria should be used to consider whether or not an individual (represented by the various beads received by the group) belonged to the same species?

We consider that the emergence of doubts, insecurities and uncertainties in the face of a new situation, especially one that involves real problems related to the student's professional performance, is one of the factors that stimulate reflection and the critical and significant positioning of the individual. By questioning themselves, from the beginning, about the criteria to be considered for the execution of the activity, students adopt an active posture in the construction of knowledge and position themselves as subjects capable of solving situations from the search for information and the association with pre-existing knowledge on the subject, reducing access to ready-made information and opening space for questioning and reflection.

Araújo and Silva (2024) argue that, in the process of teacher education, the knowledge that involves the teaching of Science and Biology should not be restricted only to contents and theories presented as ready and immutable information. Instead, a set of pedagogical practices that promote a significant social transformation during the students' training process should be prioritized, that is, pedagogical practices need to make sense for students, encouraging them to seek new answers and discoveries and to formulate new questions based on the knowledge being accessed.

It is necessary to highlight that the insertion of activities with a playful character, such as the activity proposed in this research, helps in the development of the perception of something innovative by the students, directing greater attention and curiosity to the activity in question. Carvalho *et al*. (2021) corroborate this idea by stating that the playfulness in the production of didactic models or in the use of practical didactic materials in the teaching of Biology arouses the curiosity of students, as they can observe, touch and perform various configurations with the available material. This allows students to make, restructure and visualize structures that would be worked only in

theory, contributing to cognitive development, learning performance and increased interest in the discipline and concepts covered.

Based on the analysis of the answers obtained from the questionnaire applied, we highlight that 72% of the participants stated that they had previous knowledge about the concepts of species richness and abundance. This suggests that the concept of species was previously addressed in Basic Education, becoming significant enough to remain in the memory of students. However, in contrast to this data, Rôça, Monteiro and Siqueira-Batista (2008) argue that the diversity of species concepts is often not presented to students of the Biology degree and even less to students of Basic Education, since textbooks are usually restricted to the biological concept of species.

In this sense, we agree with the authors and emphasize that, until the moment of the research, the participants were only asked about the existence or not of prior knowledge about the concept of species, so we cannot yet affirm the level of depth and complexity with which this concept is present in the students' understanding. However, it is important to emphasize that, regardless of conceptual complexity, didactic resources can stimulate motivation for new discoveries. Using practical didactic resources can, therefore, motivate and excite students to establish new connections, discoveries and propositions about a given concept and/or theory (Menezes *et al*., 2024).

Continuing and following the content analysis proposed by Bardin (2016), three categories of analysis of the answers obtained regarding the perception of the students participating in the research were identified, as follows:

- Category A: students with insufficient information on the subject addressed or who are unable to prepare a satisfactory response.
- Category B: students who present valid terms, ideas and/or arguments as answers, but are unable to formulate a fully clear and coherent answer.
- Category C: students who provide coherent and valid answers to the question.

Regarding the importance of the concepts of species richness and abundance for Ecology, it was observed that 52% of the participants can be considered in category A (they do not have enough information to elaborate a satisfactory answer), 36% in category B (they present valid terms, ideas and/or arguments, but do not formulate a totally clear and coherent answer) and only 12% were able to express a response

containing terms corresponding to the concepts of species richness and abundance, demonstrating coherence in their response (category C).

In contrast to the first question, in which 72% of the participants said they knew the terms even before having contact with the discipline of Ecology, it is evident that there is a gap between what students understand by "knowing" the terms and the ability to expose and explain these concepts in a written, explanatory and exemplary way. This data does not invalidate the information that students are aware of the existence of the concept of species and, in fact, are able to exemplify some cases or differentiate some species with which they are familiar. In addition, it is worth remembering that these are students who are attending the first semester of the undergraduate course in Biology, that is, they will still have access to the study of more complex concepts on the subject.

In addition, the data are also significant when considering the complexity attributed to the concept of species by scholars in the area, as biologists and philosophers recognize that the term “species”, due to its scope in the field of Biology and its interaction with other areas, requires conceptual detailing that is still poorly understood and disseminated. In this regard, Cracraft (1987) argues that the concept of species is intrinsically linked to the ontological knowledge necessary to understand and describe diversity in nature, its processes, interactions and meanings. Thus, it is understandable that an initial contact with this concept, even if still superficial, already in Basic Education, is a viable way to deepen understanding and seek new conceptual connections during undergraduate training.

Silva and Meglhioratti (2020) add that the understanding of the concept of species is of significant importance in several disciplines besides Ecology and Biology itself. The authors argue that systematics and taxonomy use resources such as geographical and historical resources to establish necessary connections in the exemplification of species. This implies that an initial and simplified contact with the concept of species can assist in the future understanding of the complexity of the relationships that this concept presents. Thus, it is common that, initially, students tend to distinguish species based on morphological characteristics, and then understand molecular, genetic, biochemical, geographic, evolutionary relationships, among others.

It is considered, in general, that the concept of species is fundamental for the construction of knowledge about the preservation and conservation of living beings. To this end, teacher education must promote the social, political and environmental development of the subjects, going beyond a purely content-based and theoretical academic training. Thus, the objective is for teacher training courses to help future teachers understand that the reflective process is crucial to (re)build and (re)evaluate previously existing conceptions, reformulating thinking, acting and reflecting in various formative dimensions (Araújo; Silva, 2024).

Regarding the students' perception of the use of practical didactic resources to assist in the understanding of themes and concepts of Biology, it was found that 96% of the participants believe that the use of these resources provides a better understanding of theoretical subjects. However, students cannot explain in detail how this occurs and cannot cite specific examples of situations in which this relationship was experienced. This suggests that, for this question in the questionnaire, category B predominated, where students were unable to formulate totally clear or coherent answers.

Although these data indicate a perception of students about the association between practical activities and the teaching and learning process, the lack of detailed explanations prevents them from stating whether they really visualize this relationship in practice or whether they have only a superficial perception that practice is the best path to learning. In any case, we agree with Andrade, Silva and Araújo (2024), when they state that students' *feedback* on the activities carried out in the classroom is essential for teachers to reflect on their pedagogical practice and on the methodological resources used. This *feedback* can contribute to the development or restructuring of new teaching materials that better meet the specific educational needs of students and teachers.

We also add that the interaction between students and teachers directly reflects the directions that the teaching and learning process can take in the discipline, even helping to mitigate the challenges inherent in the biological area. In the context of Ecology teaching, for example, Seniciato and Cavassan (2009) highlight several challenges faced in public universities, including: 1) the need for reflective teaching that associates values with scientific knowledge; 2) overcoming structural difficulties, such as the lack of resources to carry out field classes; and 3) the fragmentation of knowledge

and the absence of interdisciplinarity with other areas of knowledge. We believe that these challenges can be partially mitigated when there is direct and clear contact between teachers and students, which can be provided by students' perceptions, by the expression of students' training needs, by the availability of structural and pedagogical resources of the institution and by the teacher's commitment to teaching practice.

Participants were asked about their ability to conceptually explain the terms “abundance” and “richness” of species after the class. The analysis of the answers revealed that 96% of the students said they were able to describe these concepts more clearly after the classroom study. Among these, 76% were grouped in category C (students who presented coherent and valid answers), while 24% remained in category B (students who presented valid terms, ideas and arguments, but were unable to formulate totally clear and coherent answers).

Although a considerable portion of the participants demonstrated an adequate understanding of the concepts, there is still a need for deepening and greater appropriation of scientific concepts. This is evidenced by the fact that some students, despite being able to correctly express the concepts, are still unable to fully articulate the interdependence between them and the contextualization necessary for a deeper understanding.

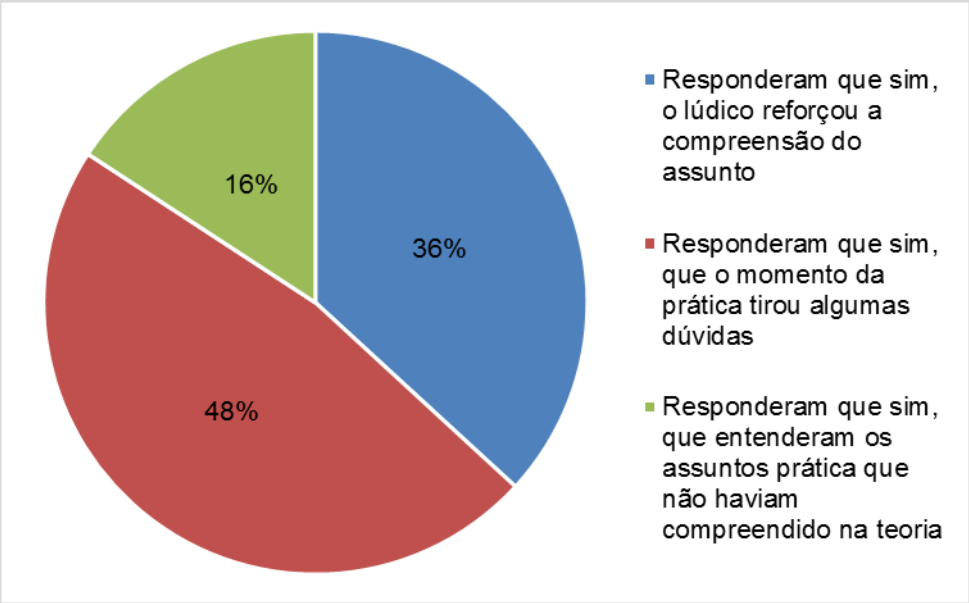
This situation is similar to that observed by Almeida, Araújo and Silva (2023), with Basic Education students, where students, despite understanding the interdependence of ecosystems, face significant difficulties with specific ecological terms, such as the concept of species. The results show that although there is a basic understanding, students often face challenges in articulating and applying concepts, resulting in responses that do not fully reflect mastery of ecological concepts.

This difficulty already exists in Basic Education, if not identified and mitigated since the beginning of initial training, can result in complex problems in the training of future teachers. Since the various scientific areas and concepts are interconnected and, in many cases, codependent, a comprehensive understanding is therefore necessary in order to truly understand the various subjects that make up the Biological Sciences and Science itself. We agree, therefore, that the training of future teachers must be based on an education that prioritizes universality, capable of providing individuals in training with

conditions for the development of dialogue, transformation, reflection and collectivity, overcoming conditions in which unilateralism and isolated realities give space to the knowledge of the complexity of things (Seniciato; Cavassan, 2009).

When asked about the possibility that the practical activity, together with the study of theory during the class taught, helped in the understanding of the concepts studied, it was found that most participants (48%) associate the use of practical didactic resources with the mitigation of doubts about theoretical concepts. Another 36% classify the resources used as playful, reinforcing that their use helps in the understanding of scientific concepts (Figure 1).

Figure 1 – Students' perception of the contribution of the use of practical didactic resources in the teaching and learning process



Source: Research data(2024).

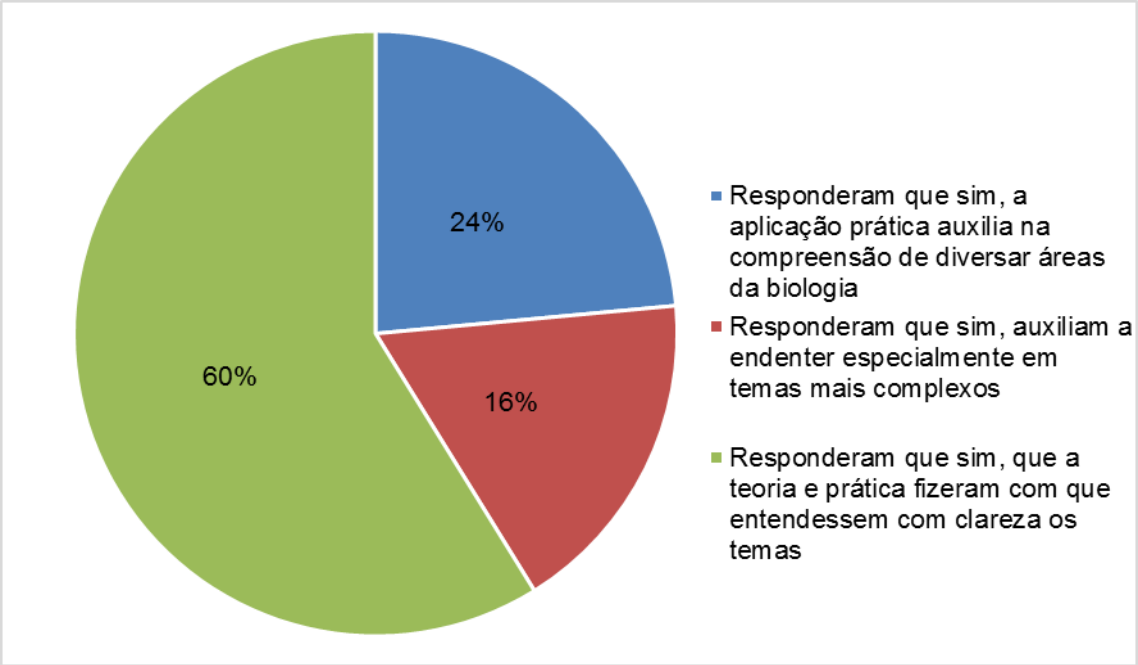
In this logic, we agree with Carvalho *et al*. (2021), when they state that the construction of playful materials is a practice that can assist in the learning of students, presenting scientific knowledge not only from a theoretical perspective, but also practical and applicable, with meanings for students. In addition, playfulness has the ability to draw students' attention, reduce the tension commonly present in the classroom, especially in the face of content considered complex by students, and contribute to the understanding of the applicability of more abstract concepts.

Motokane (2015) corroborates this by reflecting that the Biology taught in schools for years, since the emergence of this area, has the stigma of always being associated

with something complex, full of difficult terms, systematic classification little applicable and misunderstood by most students, with excessive terminology and descriptive concepts and still very abstract. Thus, in order to reduce this stigma that Biology is only an excessive amount of terms and exhaustive descriptions of processes and structures, we believe that the presentation of practical didactic resources, especially in initial training, contributes so that future teachers can rework and make use of such resources with the purpose of presenting a less complex Biology, less loaded with prejudices and adversities in its understanding for its students, in addition to increasing the practical applicability of the discipline.

When we asked students about their perception of the contribution of practical didactic resources in the teaching and learning process in Science and Biology, we found that 100% of the class was able to clearly express, in a coherent way, their position and reflection on the question. This implies that all participants were considered in category C (students who present coherent and valid answers to the question). In addition, with the detailed analysis of the responses, it was possible to produce a graph (Figure 2) showing congruences of thoughts between the perceptions and reflections of teachers in training.

Figure 2 – Students' perception of the use of practical didactic resources in the teaching and learning process in Science and Biology



Source: Research data (2024).

It is possible to notice, therefore, that most students (60%) associate the use of practical didactic resources with the achievement of clarity in the description of the studied concept. In other words, for these students, the performance of a practical activity may be associated with the departure from the subjectivity of the concept, helping them to understand the applicability of a given concept and/or theory studied. Another 24% consider that this type of activity helps in the perception and understanding of the interdisciplinarity of the concepts and 16% argue that the use of practical resources helps in reducing the complexity of the content presented.

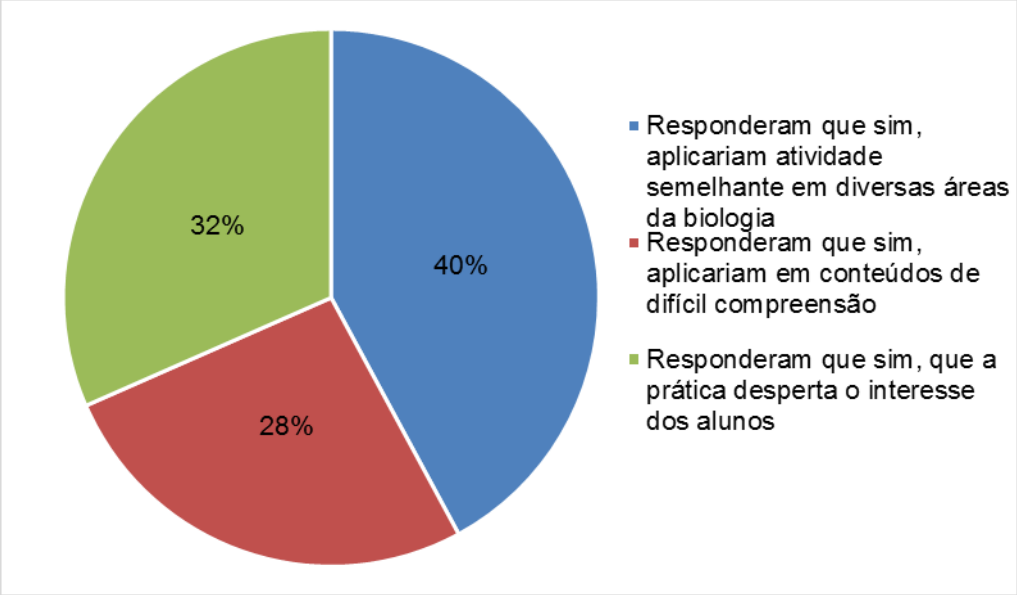
Given the data, we agree with Menezes *et al*. (2024), when they state that the relevance of teaching materials for the teaching of scientific content is mainly in the ability of these resources to assist students in the organization of their ideas and in the construction of meaningful knowledge, with which students can identify and which is consistent with their experiences and life experiences. We also agree, therefore, with the authors when they argue that, when planning a didactic resource, it is necessary to consider the previous knowledge that students have, as well as the reality in which they live, whether in geographical, cultural, social or other aspects.

Marín (2017) considers that didactic resources are tools that assist in teaching practice and contribute, when well planned and used, to the teaching and learning process. This reflection highlights the need to think of practical didactic resources as a complement to teaching practice or as an association between several methodological practices that can assist in the teaching and learning of students. However, we believe that a certain isolated didactic resource should not be attributed the function of being responsible for students' learning, nor should it be seen as the “lifeboat” of a non-significant, non-contextualized and non-reflective pedagogical practice.

This implies the need to make clear, for teachers in training, that practical didactic resources are a methodological option with a contributory capacity for teaching practice, but that their success in the applicability of concepts and student learning is associated with several factors, such as the context in which they are presented, the students' learning needs and the contextualization of the didactic resource with other areas and concepts.

When placed as future teachers, participants express the understanding that practical didactic resources favor the understanding of theoretical concepts considered more complex, demonstrating the perception that they can be used in several areas of Biology and that they have the potential to arouse the interest of students (Figure 3).

Figure 3 – Students' perception of the use (in the future in their teaching practice) of practical didactic resources in the teaching of Science and Biology



Source: Research data (2024).

In general, the participants make it clear that there was a greater understanding of the concepts worked after the proposed activity was carried out, which used the practical didactic material, that is, the students showed greater security and understanding in the applicability of the concept of species and in the relationships that this concept has with others. It is believed, therefore, that the production of pedagogical materials can help mitigate some obstacles related to the teaching and learning process, such as the lack of laboratory infrastructure and the reduced amount of pedagogical materials, which are constantly faced by public schools. In addition, it provides students with the opportunity to manipulate and explore materials, expanding the knowledge built in the classroom from theory.

However, we do not advocate that practical teaching materials replace other methodological resources essential for student learning. A didactic material will never have the scope of a field class, does not replace the experience provided by a technical

visit to a non-school space and does not replace a laboratory practical class, but we believe that this didactic resource can be a methodological strategy that enriches teaching practice and can be associated with other teaching strategies. In addition, in cases where the teacher does not have more sophisticated resources at his disposal, teaching materials can be a means of reducing the abstraction of the concepts worked on, providing students with a practical experience of the concepts and theories studied.

Carvalho *et al*. (2020) corroborate this statement by pointing out that, when explaining abstract contents and mostly of a scientific nature, often distant from the reality of the students, it is necessary to seek ways to highlight the utilitarian side of this content, exalting its applicability and importance for the lives of people and society. This also implies the need to be, as teachers, always listening to students, perceiving their needs, perspectives for the future and the reality in which they find themselves. Thus, it will be possible to reduce the distance from the teacher-student relationship and find ways for the teaching and learning process to develop satisfactorily for both sides, promoting the construction of significant knowledge (Favoretti; Silva; Lima, 2020).

At the end of the activity, the students were able to understand the applicability of the species concept to the point of organizing the material made available and presenting a classification in which the objects were distributed (hypothetically) in 15 different species. They explained in detail the richness of characteristic variations between these species and related them to existing species in nature.

It was also possible to verify that the students were able to understand the concept of variability of characteristics within the same species, as they were able to differentiate and include individuals with different colors and anatomical patterns in the same species, using broader characteristics as a taxonomic criterion. This indicates a capacity for contextualization developed throughout the activity, moving from a more restricted and superficial species concept to something more comprehensive, complex and contextualized.

It is important to note that, at the end of the class, there was a moment of socialization of the activity developed. At this moment, the students were able to present their classifications to the other components of the class and contextualize the habitat, ecological niche and/or geographic region in which they placed their classification. It was

observed that, in most cases, there was a connection with the place where the team members have their experiences. Thus, it is perceived that the educational space goes beyond a place to teach theoretical contents and can become a space of reference and expression for the various subjects (Bueno, 2001), where the exchange of experiences and life experiences takes place and where learning can be built from the knowledge and knowledge that students carry with them.

5 Final considerations

In order to discuss the perception that students of the initial training course in a degree in Biological Sciences have about the concept of species and how these future teachers understand the importance of the use of practical and diversified didactic-methodological resources in the teaching and learning process of this concept, this research highlights that the use of didactic resources is considered something promising, with sufficient potential to reduce the distance between theory and practice, in addition to stimulating the interest and enthusiasm of students in carrying out activities and mitigating the typical abstraction of some concepts in the biological area.

It was also evident that, although the students claim to know the concept of species, even at the beginning of teacher education, most of the participants were unable to explain in detail the concept of species, nor how the abundance and richness of species occur. Thus, the emergence of three categories of analysis (category A: students with insufficient information on the subject addressed or who cannot elaborate a satisfactory answer; category B: students who present valid terms, ideas and/or arguments as answers, but cannot formulate a totally clear and coherent answer; and category C: students who provide coherent and valid answers to the question) denotes the degree of students' understanding of the biological concept in question.

After a class that made use of a practical didactic resource applied to the understanding of the concept of species, the students expressed the perception that this resource contributed significantly to the teaching and learning process, classifying it as something playful and motivating. It was evident that the students were able to clearly and coherently express their positions and reflections on the questions established after

the class. In addition, most participants associated the use of practical didactic resources with a better understanding of what a species is.

On the other hand, we make it clear that an isolated didactic resource, however much sympathy and enthusiasm it manages to arouse in a class of students, will not, by itself, be responsible for learning a concept, since this process involves a complexity of factors, such as: the motivation to learn, the teacher-student relationship, the relevance of the concepts to the students, the meaning of these concepts, their practical applicability, among others.

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Chief Editor: Lia Machado Fiuza Fialho

***Ad hoc reviewers*:** Fernanda Fernandes dos Santos Rodrigues and Raquel Carine de Moraes Martins

Translated by: Thiago Alves Moreira

How to cite this article (ABNT):
PEREIRA, Cássia Cristine Costa; ALBUQUERQUE, Flávio; SILVA, Natanael Charles da. O conceito de espécie em debate: reflexões e percepções de estudantes da licenciatura em Ciências Biológicas. *Educação & Formação*, Fortaleza, v. 10, e14239, 2025. Available at: https://revistas.uece.br/index.php/redufor/article/view/e14239

Received on January 9th, 2017

Accepted on April 25th, 2025.

Published on May, 27th, 2025.