

Ethnobotany and Science Teaching: appreciation of traditional communities in times of crisis

PEDAGOGICAL PRODUCT

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Abstract

This article aims to present a sample of a Didactic Sequence, with activities, suggestions for interdisciplinarity and development for the classroom. The main objective of this study is to present a pedagogical product originating from ethnobotanical research, which links traditional and scientific knowledge, aiming to enrich teachers' practices with practical and contextualized activities. The Didactic Sequence (DS) is based on five stages: choice of the theoretical-methodological framework, selection of two traditional tales, selection of the theme, definition of learning objectives and selection and elaboration of activities. DS comprises four classes with methodologies adopted to carry out activities including reading, presentation of ethnobotanical stories, dialogued expository classes, debates, and group and individual work. In this way, this work highlights the importance of a contextualized teaching approach, especially in the field of botany. This approach can provide a deeper understanding of the interconnections between culture, environment and science.

Keywords: Ethnobotany. Scientific knowledge. Science teaching. Botany.

Etnobotânica e o Ensino de Ciências: valorização das comunidades tradicionais em tempos de crise

Resumo

Este artigo visa a apresentação de um recorte de uma Sequência Didática, com atividades, sugestões de interdisciplinaridade e desenvolvimento para a sala de aula. O objetivo principal deste estudo é apresentar um produto pedagógico originado de uma pesquisa etnobotânica, que vincula os saberes tradicionais e científicos, visando enriquecer as práticas dos professores com atividades práticas e contextualizadas. A Sequência Didática (SD) está fundamentada em cinco etapas: escolha do referencial teórico-metodológico, seleção de dois contos tradicionais, seleção do tema, definição dos objetivos de aprendizagem e seleção e elaboração das atividades. A SD compreende quatro aulas, utilizando metodologias adotadas para a realização das atividades incluindo leitura, apresentação de contos etnobotânicos, aulas expositivas dialogadas, debates, e trabalhos em grupo e individuais. Dessa forma, este trabalho destaca a importância de uma abordagem de ensino contextualizada, especialmente no

campo da botânica. Esta abordagem pode proporcionar uma compreensão mais aprofundada das interconexões entre cultura, ambiente e ciência.

Palavras-chave: Etnobotânica. Conhecimento científico. Ensino de Ciências. Botânica.

1 Introduction

2

The aim of science teaching is to enable students to correlate scientific knowledge with the reality in which they live, fostering the development of the ability to formulate hypotheses, experiment, reason about facts and, based on the data, build their conclusions through the phenomena observed (Brasil, 1997; Tenreiro-Vieira; Marques, 2016). In science teaching, the essential raw material is the scientific content of the subjects, and it is essential to recognize that this knowledge is constructed from the historical, social and cultural context (Brasil, 1997; Leite; Gradela, 2017; Ursi *et al.*, 2018). Therefore, it is essential that these aspects are integrated in schools (Bianchetti Rodrigues; De Quadros, 2020).

Given the importance of teaching science in a more contextualized and problematizing way, this research chose to develop the teaching of botany using traditional knowledge as a starting point. Botany is one of the largest areas of knowledge in Biology and is the science that studies the morphological, genetic, physiological and evolutionary characteristics of plants (Amadeu; Maciel, 2014).

In a community, there is vast knowledge about plant diversity, which results in a wealth of information about the flora that surrounds it, generating possibilities for interaction between this knowledge and society, with the aim of providing for the survival needs of these communities (Silva *et al.*, 2015; Ursi *et al.*, 2018). In this way, it is important to understand the mutualities between scientific and popular knowledge, and for this, it is necessary to understand the field of Ethnobotany. According to Albuquerque (2005, p. 6), ethnobotany is “the study of the direct interrelationship between people from living cultures and the plants in their environment”. However, the broadening of the concept of Ethnobotany used today has made it possible to extend its field of investigation to the study

of both traditional populations and non-traditional urban-industrial and rural societies. Ethnobotany is also an interdisciplinary science, which facilitates its interaction with other sciences (Albuquerque, 2022).

Therefore, through the traditional knowledge about plant species brought by students, the challenge of enabling students to develop the skills necessary for scientific literacy can be achieved by Ethnobotanical studies (Lima *et al.*, 2020).

In this context, the main objective of this study is to present a pedagogical product originating from Ethnobotanical research, which links the traditional and scientific knowledge of a specific community, with the aim of enriching teachers' practices with practical and contextualized activities.

2 Referencial teórico

This topic will focus on the theoretical basis of this study. The topic is structured as follows: theoretical assumptions about botany, the concept of ethnobotany, teaching science in elementary school and the importance of popular knowledge, and the relationship between scientific knowledge and ethnobotany.

2.1 Theoretical assumptions about botany

The area of Biology that studies plants is called Botany (Evert; Eichhorn, 2014). Botany is divided into several sub-areas, such as: Systematics (nomenclature, identification and classification of plants), Physiology (vital activities), Organography (external morphology), Anatomy (internal morphology), Palynology (pollen), Phytogeography (distribution of species), Paleobotany (plant fossils), Genetics (study of DNA), Plant Ecology (relationship between plants, other living beings and the environment), Agricultural Botany (planting and cultivation activities), among others (Martins-da-Silva *et al.*, 2014).

Although botany as a science is recent (Oliveira, 2003), the study of plants was part of man's earliest knowledge. In order to feed himself, he needed to select the parts of the plant he was going to use and distinguish between toxic and non-toxic plants, for his own consumption and for animal consumption (Chassot, 2001). Since the dawn of human existence, humans have looked to nature for resources to improve their own living conditions, increasing their chances of survival (Martelli; Carvalho, 2019).

According to Ursi *et al.* (2018), the study of plants has been beneficial to the advancement of science. However, studies on flora must include strategic actions aimed at obtaining better economic use, strengthening science and generating benefits for society, ensuring that these resources are available for future generations (Souza *et al.*, 2013).

In view of this, plants are considered indispensable for the well-being of peoples, providing materials for building houses, clothing, weapons, dyes, food and medicines. Some isolated tribal populations, for example, are able to identify hundreds of plants. Even without knowing the term “Botany” or its connection to Science, for these populations, plants have an even more fundamental meaning: they are an integral part of life itself, so essential that survival would be impossible without them (Went, 1968).

The affinity between primitive humans and plants arose from the moment our ancestral species linked the development of seeds, the growth of crops and the production of food, which marked the beginning of agriculture (Perim *et al.*, 2021). In this way, it is possible to stimulate interest in botany by analyzing its usefulness and importance. Plants have always been of great importance to people's well-being (Wend, 1968).

2.2 Concept of Ethnobotany

In order to find alternatives for their survival and improve their quality of life, plants were part of man's earliest knowledge (Chassot, 2001; Martelli; Carvalho, 2019).

In the Neolithic period, approximately 10,000 years ago, humans living in the Middle East discovered that they could harvest certain grasses and that these, if planted,

would provide them with a higher yield the following season. This moment in evolutionary history may have been one of the first moments of interaction between man and the plant world (Went, 1968).

Therefore, as already mentioned, in a community, the interactions between society and plants generate a wealth of knowledge about the diversity of plants that surround them (Silva *et al.*, 2015; Ursi *et al.*, 2018). In this context, ethnobotany acts as a mediator between academic knowledge and local or traditional ecological knowledge. Its function is to prevent empirical knowledge related to the use of plants from being lost, rescuing part of a community's cultural heritage, since knowledge is built on relationships with the surrounding nature (Meyer *et al.*, 2012).

It is therefore important to understand the interrelationships between scientific and popular knowledge. To do this, we need to understand the field of ethnobotany. Ethnobotany is an interdisciplinary science, which facilitates its interaction with other sciences. Thus, Ethnobotany expresses itself through different connections, configuring itself as a field of Anthropology, Ecology and Botany. However, it is still necessary to go through a process of reflection that assumes, via interdisciplinarity, the diversity of scientific, academic and epistemological projects (Albuquerque, 2022).

In developing countries such as Brazil, the construction and transformation of ethnobotany takes place against a backdrop of cultural and biological diversity, generating a heritage with significant potential, including plants of commercial interest, and enabling the generation of sources of income with environmental sustainability (Oliveira *et al.*, 2009).

In the making, Brazilian ethnobotany, especially with traditional medical practices in mind, has gone through several phases. Initially, research was carried out mainly with Brazilian indigenous peoples and by non-Brazilian researchers, especially English and Americans. Over the years, ethnobotanical research has come to emphasize the interrelationship between men and plants and, with this, to investigate how different peoples interact with the plant resources that surround them; how they perceive and classify their plants and landscapes; what are the ways in which these plants are used; what are the biological and cultural implications of these types of uses; how genetic

diversity is manipulated; and what are the biological and cultural implications of this manipulation (Albuquerque, 2022).

Although there are still some gaps to be filled, there has been an increase in the number of publications of ethnobotanical studies in scientific journals in recent years (Oliveira *et al.*, 2009). These studies address the use of plants for mystical, ritualistic, symbolic-affective and/or magical-religious purposes, contributing to the expansion of ethno-knowledge within the plurality of plant uses (Silva *et al.*, 2018). This new phase in ethnobotanical thinking, which discusses the manipulation of biological diversity, was reinforced especially in 1988, when the First International Congress of Ethnobiology was held in Belém, which states that: “[...] biological diversity is closely linked to cultural diversity” (Albuquerque, 2022, p. 133).

In this way, maintaining cultural diversity also means preserving biological diversity (Albuquerque, 2022). In Brazil, three main ethnic groups make up the cultural base: indigenous, African and European. The popular use of medicinal plants for therapeutic purposes has diverse origins, deriving mainly from indigenous practices, Afro-Brazilian beliefs and African and European traditions (Berg, 1993). Brazil's indigenous people, who are native to the territory, have vast ethnobotanical knowledge. However, they face a long history of violence, persecution, discrimination and expropriation. The current situation is serious, with intense and continuous pressure on these peoples, aggravated by the dismantling of the already fragile national structure for protecting indigenous peoples and the environment. This scenario reveals persistent episodes that slowly and gradually continue to threaten the survival of indigenous peoples (D'Almeida, 2020).

However, regardless of social contempt, linguistic and cultural influence, and contributions through medicinal knowledge and agricultural practices, indigenous peoples are part of the identity of all those who share Brazilian nationality (Ribeiro, 1987).

In this way, some factors can have a direct impact on the indigenous community, such as: forced assimilation, forced displacement to environments with different ecosystems to which they are accustomed and hold ancient knowledge, violence against indigenous leaders, public health policies that do not take into account the specific needs

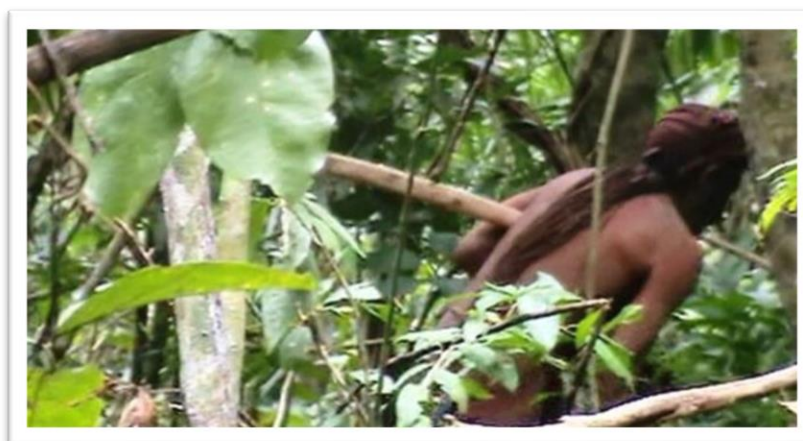
of indigenous peoples and the environmental degradation of their lands as a result of highly impactful economic activities. These factors are just some of the mechanisms through which indigenous genocide occurs, even in times of peace (D'Almeida, 2020).

In addition to cases of ecocide and genocide, ethnocide also occurs, as described by Clastres (1982):

If the term genocide refers to the idea of “race” and the will to exterminate a racial minority, ethnocide points not to the physical destruction of men (in which case one would remain in the genocidal situation), but to the destruction of their culture, and is therefore the systematic destruction of the ways of life and thinking of peoples different from those who undertake this destruction. In short, genocide murders peoples in their body, ethnocide kills them in their spirit” (Clastres, 1982, p. 55).

In both cases, “it is always death, but a different kind of death: physical and immediate suppression is not cultural oppression with long-delayed effects, according to the capacity of the oppressed minority to resist” (Clastres, 1982, p. 55). The death of the last indigenous person voluntarily isolated from the Tanaru Indigenous Land, known as the “Índio do Buraco” (Figure 1), illustrates the extinction of a people in the middle of the 21st century (Brasil, 2022).

Figure 1: Photos of the last Indigenous people of Terra Tanaru



Source: Funai. Available at: <https://www.facebook.com/Funaioficial>. Accessed on: 15/03/2023.

The term “isolated indigenous peoples” refers specifically to indigenous groups who have no permanent relations with national societies or who interact infrequently, either

with non-indigenous people or with other indigenous peoples. Historical records show that the decision to isolate these peoples can be the result of encounters with negative effects on their societies, such as infections, diseases, epidemics, death, acts of physical violence, plundering of their natural resources or events that make their territories vulnerable, threatening their lives, their rights and their historical continuity as culturally differentiated groups (FUNAI, 2021).

It must be borne in mind that indigenous cultures are becoming extinct, little by little, every day. It is therefore urgent not only to work hard to record vital data, but also to fight to preserve the lands, freedom and right to exist of indigenous peoples. They “are a living heritage that humanity cannot afford to lose” (Posey, 1987, p. 84).

It can be seen that, since the time of the discovery, indigenous peoples had access to a great diversity of plants and animals, lived in harmony with nature and used certain plants for food and to treat their illnesses. Information on the interactions between indigenous people and their habitat is valuable for understanding ecological interrelationships (Posey, 1987). Therefore, this traditional knowledge acquired over generations is important not only for the survival of humans, but for all living beings living in the same area (Diegues *et al.*, 2000).

One way of observing the interactions between humans and nature is by analyzing national parks. An example of this occurred in the Serengeti and Ngorongoro parks, in Tanzania and Kenya, respectively. In these parks, groups of pastoralists carried out agricultural management activities in such a way that livestock and wild animals coexisted, creating a landscape that is now valued by conservationists. However, with the establishment of the park and the exclusion of these tribes, the herbivores were negatively affected, causing an imbalance in the biological diversity of the region (Diegues *et al.*, 2000).

In this context, from a scientific point of view, concern about the environmental issue arose in the 1960s, driven by a moral and political duty to denounce the degradation and destruction caused by anthropic actions. It is important to carry out in-depth studies and review certain paradigms. As discussed above, human actions and natural beings can

and are capable of not only co-evolving, but also maintaining and restoring life support systems (Melo *et al.* 2021).

In view of the above, it can be concluded that, although there is a growing appreciation of traditional knowledge, reflected in the search for an emic perspective (i.e. the perspective from the popular point of view), it is possible to observe the emergence of work with urban and non-traditional populations. Studies carried out in backyards in urban areas, for example, show that it is feasible to carry out ethnobotanical research in both industrialized and non-industrialized societies, including both traditional and non-traditional populations (Oliveira *et al.*, 2009).

Ethnobotanical research in Latin American countries is very wide-ranging. Research is carried out on medicinal plants, domestication and the origin of agriculture, archaeobotany, edible plants, ethnobotanical studies in general, agroforestry systems and backyards, forest use, cognitive studies, historical studies, and research carried out in markets (Lucena; Lucena, 2020).

Thus, ethnobotanical studies are important because they contribute to the dissemination of already known ethnospecies, record traditional knowledge about local flora, and are valuable in the discovery of new species and for the cultural rescue of communities. They also make it possible to publicize the existence and culture of these communities (Sousa *et al.*, 2022). In this way, it is possible to approach traditional knowledge in different ways, with different perspectives, in an interdisciplinary, inclusive and socially responsible manner (Albuquerque, 2022).

2.3 Science teaching in elementary school and the importance of popular knowledge

In recent years, Brazil has undergone intense economic and social changes, which are reflected in the way society envisions the country today and in the future. However, even with the economic and social growth of a large part of the population, universalized and quality education still remains a critical issue (Silva *et al.*, 2017).

Concern about problems related to science teaching can be seen in the content and quality of scientific research, as well as in the relationship between the classroom and teaching practice. The aim of these inquiries is to seek quality education for all (Delizoicov *et al.*, 2009).

Although science is present in the reality of the population, the teaching of this subject is often distanced from the context of the students, who are unable to see the connection between what is studied in the classroom and everyday life. For this reason, it is necessary to develop pedagogical practices that promote meaningful learning, as well as initiatives that link the school with families and the community (Brasil, 2009).

Although topics related to ethnobotany are absent from the official school curriculum, it is possible to involve them in school activities, using the local ecosystem and students' previous knowledge of plants as a starting point (Pereira, 2014), boosting their interest in scientific teaching (Kovalski; Obara, 2013).

By using this knowledge, it is possible to arouse interest in traditional knowledge, science and natural products. Therefore, using methodologies that value students' experiences, knowledge, interests and curiosities about nature is a form of interaction and an incentive to carry out ethnobotanical studies in basic education (Castro *et al.*, 2021).

Furthermore, in a post-COVID scenario, Ethnobiology, like other sciences, faces major challenges, such as conserving biodiversity, defending the territories of traditional peoples and communities, valuing sociobiodiversity products for local economies and global health as a whole (Soldati; Barros, 2020).

Therefore, strategies to promote science education must be guided by the interests, needs, desires and worldviews of the public for whom access to science is essential. In this context, dialog between different cultures is fundamental, and the words “mediation” and “dialog” become fundamental in the process of teaching, learning and disseminating science (Krasilchik, 2008).

Thus, by integrating dialog and cultural mediation into science teaching, it is possible to improve the epistemological construction of knowledge, breaking with traditional paradigms and methodologies. This approach makes it possible to develop both scientific

knowledge and popular knowledge, positioning students as active subjects in their learning and presenting science as a social and cultural production (Sganzerla *et al.*, 2021, p. 81).

In this way, it is possible to work on the importance of ethnobotany based on the characteristics observed between traditional and scientific knowledge, highlighting their discrepancies and similarities, through the perception of the importance of plants (*Plantae* Kingdom) in human life, valuing people, the knowledge they possess and their personal relationships (Siqueira; Pereira, 2014).

2.4 Relations between scientific knowledge and ethnobotany

Ethnobotany contributes to the conservation of biological diversity, including plants of commercial interest. It makes it possible to generate sources of income with environmental sustainability and contributes to the preservation of ethnic groups (Oliveira *et al.*, 2009).

In this context, Brazil, as the holder of the greatest biological diversity in the world and considered one of the most important megadiverse countries on the planet, is home to between 20 and 25% of all global species. In addition, the country is rich in cultural diversity, with more than 200 indigenous peoples and diverse communities such as quilombolas, caiçaras and rubber tappers. However, a significant part of the Brazilian flora has not yet been sufficiently analyzed from the phytochemical, biological and pharmacological points of view (Magalhães, 2017), which highlights the importance of Ethnobotany for the exploration and preservation of this biodiversity.

Therefore, in order to guarantee the well-being and health of the population, it is necessary to know the reciprocal interactions between organisms. For this to happen, it is necessary to observe nature, understand its language, participate and question the possible modes of intervention (Gottlieb *et al.*, 1998) and also understand the most varied ways of using natural resources (Brasil, 1997).

In Brazilian legislation, Decree 6.040 of February 7, 2007, which establishes the National Policy for the Sustainable Development of Traditional Peoples and Communities, defines the term traditional populations in Article 3, Annex I, as:

I - Traditional Peoples and Communities: culturally differentiated groups who recognize themselves as such, who have their own forms of social organization, who occupy and use territories and natural resources as a condition for their cultural, social, religious, ancestral and economic reproduction, using knowledge, innovations and practices generated and transmitted by tradition (Brasil, 2007).

Unfortunately, when analyzing the historical and social context of the production of scientific knowledge, it can be seen that science has favored the construction of discriminatory acts, what we now know as modern racism (Silvério; Motokane, 2019). These processes erase cultures and, consequently, knowledge that does not have a fully scientific methodology, strengthening and intensifying social inequalities and the characterization of scientific thinking (Panteleão; Batitucci, 2022).

Therefore, according to Marconi and Lakatos (2003, p. 76), “science is not the only way to access knowledge and truth”. The same object or phenomenon can be observed by both scientists and ordinary people. However, it is the way in which the object is observed that leads to scientific knowledge. It is therefore the form, the way or the method and the instruments of “knowing” that distinguish scientific knowledge from popular knowledge. To be considered scientific knowledge, it is necessary to analyze the particularities of the object or phenomenon under study.

Ethnobotany, therefore, is a branch of ethnobiology that studies various types of knowledge about plants without attempting to rank them. These sciences (Ethnobiology and Ethnobotany) do not intend to deconstruct scientific knowledge in order to highlight other forms of knowledge, since human knowledge is not exclusively the result of biology or culture; it arises and is constructed by different factors that have occurred throughout history (Albuquerque, 2022).

In this context, Ethnobotany contributes to the study of the use of plants, such as: the use of plants as medicines or raw materials; the development of land use; agriculture; forestry; cultural conservation; flora classification and nomenclature systems; strategies for

managing plant resources; the identification and search for solutions to conservation and sustainable development problems; education and the development of healthy food industries; and the way in which plants are inserted into the symbolic universe of populations, in addition to reducing food shortages and difficulty in accessing medicines, since it is the poorest people, in particular, who are most dependent on wild plant resources (Hamilton *et al.* , 2003).

3 Methodology

In this section, we will describe the methodological aspects of the Didactic Sequence (DS) and the theoretical foundations that supported its construction. The Didactic Sequence was developed and based on 5 stages:

Stage 1 - Choosing the theoretical-methodological framework: seeking support in the theoretical and methodological frameworks of research in Botany (Evert; Eichhorn, 2014), Ethnobotany (Chizzoti, 2009, Moura *et al.*, 2021, Albuquerque, 2022), and Didactic Sequence (Zabala, 2010).

Stage 2 - Selection of the traditional tale: to prepare the Didactic Sequence, a traditional tale about plants known in the community was selected and activities involving traditional and scientific knowledge were developed using it.

Stage 3 - Selection of the theme: the choice of the theme “Ethnobotany and Science Teaching: integrating and valuing traditional communities in times of crisis” makes it possible to establish discussions that explore the interrelationships between scientific knowledge and socio-environmental aspects, such as plant biodiversity and its relationship with other living beings, plant physiology and morphology, medicine production, ethics, relations between society and nature, socio-scientific debates, among others.

Stage 4 - Defining the learning objectives: In this stage, the general and specific objectives to be achieved through the development of the DS were established. This involves identifying the competences and skills that students should develop during the course of the DS.

Stage 5 - Selection and preparation of activities: In this stage, the activities that will be developed throughout the Didactic Sequence were selected and designed. The activities were planned with the aim of integrating the students' reality, their socio-cultural contexts, with scientific knowledge, specifically the topic of the *Plantae* Kingdom. This integration is achieved by carrying out activities that not only focus on the scientific content, but also value the students' ethnobotanical knowledge.

4 Educational product

The classroom should not be a place for the simple linear transmission of knowledge, but rather a rich space for clarification and discussion on previously programmed and studied topics (Sá; Moura, 2008).

When analyzing how plants are discussed throughout Basic Education, it was observed that the term “plant” appears for the first time in the BNCC for children in early childhood education, aimed at very young children (one year and seven months to three years and 11 months). The skill (EI02ET03) aims to share, with other children, situations of caring for plants and animals in the institution's spaces and outside it.

The term then appears in Primary School I, in the Thematic Unit Life and Evolution, Object of Knowledge: Living beings in the environment - Plants, associated with the skills (EF02CI04), (EF02CI05) and (EF02CI06). In Elementary School II, the word “plant” only appears in the eighth grade in the Thematic Unit Life and Evolution, Knowledge Object: Reproductive mechanisms, in Skill (EF08CI07).

In Geography, the word appears in Elementary School I, in the third year, in the Thematic Unit Nature, environments and quality of life, Knowledge Object: Production, circulation and consumption, in Skill (EF03GE09). The word “plant” was not found in the BNCC of the New Secondary Education (Brasil, 2015).

The multidisciplinary approach of ethnobotany allows for a deep understanding of the relationship between human communities and flora, underlining the importance of incorporating such studies into the development of educational activities. In the urban

context, ethnobotanical studies can focus on environments such as gardens, vegetable gardens and backyards, which are areas rich in varieties of plant species.

These places stand out not only for their ecological composition and functionality, but also for their economic contribution, such as the production of fruit for consumption and sale (Moura; Oliveira, 2022). In addition, street markets, where plants are sold, represent a promising environment for ethnobotanical studies, showing the direct interaction between society and plant diversity (Albuquerque, 1997).

Given this, the importance of plants transcends their economic and ecological applications; they are fundamental to terrestrial evolution and the maintenance of life on the planet, as ancestral producers of oxygen and supporters of biodiversity (Sadava *et al.*, 2009). These attributions highlight the need to include the study of plants and their interactions with human societies in lessons, emphasizing their relevance not only biologically, but also culturally and economically.

From this perspective, we seek to carry out activities in which the teacher is the mediator with teaching strategies that place the student as the subject of their learning (Sganzerla *et al.*, 2021), that is, using methodologies that place the student at the center of the teaching and learning process, favoring the construction of knowledge by the student (Miranda, 2015).

4.1 The didactic sequence proposal

This Didactic Sequence (DS) is an excerpt from an educational product developed in the dissertation for a professional master's degree in Science Teaching at the Federal University of Ouro Preto. The activities proposed in the Didactic Sequence were developed based on ethnobotanical tales collected and adapted according to the grade and age group of the students involved.

The educational product includes activities, suggestions for interdisciplinarity and development for the classroom. The aim was to evaluate the pedagogical consequences of teaching and learning science through the application of a Didactic Sequence that

integrates traditional and scientific knowledge. The DS presented was designed with the aim of integrating the reality of the students and their socio-cultural contexts with scientific knowledge, specifically the topic of the Plantae Kingdom. This integration is achieved by carrying out activities that focus on scientific content and value the students' ethnobotanical knowledge.

According to Zabala (1998), a Didactic Sequence is a series of ordered and interlinked activities, organized in such a way as to meet the objectives set by the teacher and promote student learning. The proposed activities stimulate communication and emotional interactions between teacher and students, and between the students themselves. They also encourage the social organization of the classroom (individually or in groups), the broad conception of the classroom as a space and time for the teaching and learning process. With well-designed planning, the DS proposes the use of curricular materials and a continuous assessment procedure (Zabala, 1999). To complement the didactic material, tips are provided on videos and films related to the topic, enriching the learning experience and offering students different perspectives on the subject.

It is therefore the responsibility of educators to frequently integrate content related to ethnobotany into their teaching practices. By doing so, they not only enrich the curriculum, but also foster in students an appreciation for plant diversity and its indispensable role in both the ecosystem and society.

The activities proposed in the DS are aimed at the 7th year of elementary school, but we believe that the DS presented here can be adapted and developed with students in the 8th year of elementary school and the 2nd year of secondary school. In addition, according to the teacher's interest, the Didactic Sequence can serve as a review of 6th grade skills, 7th grade skills, as well as prerequisites for the development of the general skills set out in the BNCC for the 8th grade and 2nd grade high school class. The themes favor the development of activities in an interdisciplinary way with Arts, Geography, History and Portuguese Language, as suggested in the text.

Chart 1 presents a concise summary of the DS, detailing the essential components that formed part of the entire teaching-learning process. This summary includes the general

objective, the stages, the themes, the assessment methods used and the teaching resources used.

Chart 1 - Summary of the DS, consisting of general objective, stages, themes and evaluation methods.

Stages	Theme	General Objective	Specific objectives	Assessment
Lesson 1	The use of medicinal plants throughout human evolutionary history.	To explore the traditional knowledge associated with the medicinal properties of plants, their historical uses and potential contributions to health as alternative, complementary or natural treatments.	Explore the short story “The Power of Watercress”. Understand the history of watercress and its medicinal use, as well as its implications for health. Discuss how plants have medicinal properties and how this may have helped man in history. Understand the processes of morphological and genetic changes caused by the process of plant selection.	Students will be assessed on the development of group work and participation in discussions.
Lesson 2	The use of medicinal plants: safety and efficacy.	To analyze the pros and cons of using medicinal plants and promote a discussion about their efficacy and safety.	Organize a classroom debate on the rational use of medicinal plants. Explore the knowledge of plants in students' daily lives. Emphasize the importance of scientific knowledge about medicinal plants, such as how they are used, their benefits, risks, regulations, evidence and efficacy.	Students will be assessed on the development of group work and participation in discussions.
Lesson 3	Traditional knowledge, ethics and scientific knowledge I.	To disseminate information and produce knowledge about medicinal plants in a critical, meaningful, reflective and ethical way.	Disseminate information and produce knowledge about medicinal plants in a critical, meaningful, reflective and ethical way. Create information posters on how medicinal plants affect health, highlighting their potential benefits, associated risks and challenges.	Students will be assessed on their presentation, development of group work and participation in discussions.
Lesson 4	Influence of climate change on traditional knowledge, biodiversity,	To analyze, understand and reflect on the importance of valuing and respecting	Analyze the protection of traditional knowledge in Brazil. Explore ethical dilemmas related to the use of medicinal plants. Highlight how traditional knowledge is associated with biodiversity. Encourage appreciation and respect for	Students will be assessed on their participation in discussions.

	ethics and scientific knowledge II.	cultural practices and traditional knowledge associated with the use of medicinal plants.	traditional communities and their culture. Highlight how climate change can affect the ecological knowledge of traditional communities.	
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4.2 Exploring the interdependence between humans and plants

The use of medicinal plants is a historical practice in various cultures around the world. However, this practice currently faces challenges related to its regulation, efficacy and safety. In this context, the following questions arise: “*What is the role of medicinal plants in health? What are the potential benefits, associated risks and challenges involved in their use?*”

The questions encompass the intersection between the social, cultural and scientific aspects of medicinal plant use, exploring both the possible health benefits and the social, economic and regulatory implications involved. Some points to consider for the analysis are: potential benefits of medicinal plants; scientific evidence and safety; regulation and product quality; socio-economic and cultural aspects; and education and awareness.

When analyzing the issue of the use of medicinal plants in public health, it is essential to consider the potential benefits, the associated risks and the challenges involved. This analysis requires a multidisciplinary approach that incorporates scientific, social, cultural and regulatory perspectives in order to promote informed and balanced decision-making regarding the use of medicinal plants in today's society.

4.3 Description of the Didactic Sequence activities

The short story “The Power of Watercress” (Chart 2), presented by participant P50, was used as the starting point for the four subsequent lessons. The original story is

available in the master's thesis “Contributions of ethnobotany in the articulation between traditional knowledge and the processes of teaching and learning in Sciences” by the Federal University of Ouro Preto.

Chart 2 - Short story “The Power of Watercress” (adapted).

O PODER DO AGRIÃO

Em uma comunidade simples e com poucos recursos tecnológicos, os moradores contam uma história envolvendo o agrião (*Nasturtium officinale*). Segundo os mesmos, havia um homem que sofria de severas dores abdominais aos quais nenhum médico da época conseguia tratar. Um certo dia, ele saiu para a mata a procura de lenha e acabou se perdendo na mata, após passar horas sem comer e beber água, com o estômago roncando de fome e garganta ardendo de sede, o homem percebeu que havia um pequeno fluxo de água, próximo de onde ele se encontrava. Ele então, dirigiu-se até lá a fim de beber alguns goles de água, e ao chegar ele encontrou diversas plantas de agrião que cresciam sobre o pequeno córrego. Faminto e sem muita opção, o homem comeu agrião

diariamente, até que foi resgatado por moradores que o procuravam. Ao chegar no pequeno vilarejo, o homem percebeu que suas dores simplesmente cessaram. Ao contar a seus compadres que ele estava isento de suas mazelas, os mesmos ficaram curiosos com o motivo de ele ter se curado, e ao contar que havia apenas comido agrião muitos não acreditaram na sua história. Mesmo com a não aceitação dos moradores, ele resolveu cultivar a planta para seu consumo próprio. No entanto, algumas pessoas que sofriam dessa mazela por anos e sem sucesso de melhoras, resolveram procurar o senhor com ensejo de sua cura. Com o uso regular do agrião, muitas pessoas se curaram dos problemas gástricos e com isso, a hortaliça se tornou conhecida por todos e passou a fazer parte da cultura alimentícia e medicinal da comunidade

Source: Authors (2023).

It is important to emphasize that the steps presented are general guidelines and can be adapted according to the teacher's interest, the degree of learning and difficulties of the students and the specificities of each school or educational context.

4.3.1 - Lesson 1 - Interdependence between humans and plants

The general aim of the first lesson is to explore the traditional knowledge associated with the medicinal properties of plants, their historical uses and potential contributions to health as alternative, complementary or natural treatments.

The specific objectives of this lesson are: to understand the history of watercress and its medicinal use, as well as its implications for health, to discuss how plants have

medicinal properties and how this may have helped man in history, and to understand the processes of morphological and genetic changes caused by the process of plant selection.

To carry out this lesson, the teaching resources used will be: chalkboard, pencil, student notebook, textbook, colored pencils and pen. Chart 3 highlights the competences, skills and possible subjects that can be involved to develop the theme in an interdisciplinary way.

Chart 3: Competences and skills developed.

<p>Objetivo de aprendizagem</p> <p>Explorar os conhecimentos tradicionais associados às propriedades medicinais das plantas, usos e potenciais contribuições para a saúde, como tratamentos alternativos, complementares ou naturais.</p> <p>Competências e Habilidades desenvolvidas</p> <p>Ciências da Natureza: competência geral 1, 2 e 9, competência específica 1e 2 de Ciências da Natureza para o Ensino Fundamental, habilidade EF07CI07 conteúdo do 7º ano, ambas previstas na BNCC.</p> <p>Sugestão de interdisciplinaridade para esta aula:</p> <p>História: habilidades EF07HI02, EF07HI03, EF07HI10 da BNCC previstas para o 7º ano.</p> <p>Artes: revisão da habilidade EF69AR03P6 referente ao ano anterior.</p> <p>Geografia: revisão das habilidades EF06GE01, EF06GE02, EF06GE07, EF06GE11, ambas da BNCC referentes ao ano anterior.</p> <p>Língua Portuguesa: habilidades, EF69LP03, EF69LP25, EF67LP27, EF67LP28, EF69LP14, ambas da BNCC previstas para o 7º ano.</p>
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Source: Authors (2023).

The lesson will be divided into three steps. As shown in Chart 3, this activity enables integration with other subjects such as Arts, History, Geography and Portuguese Language, encouraging students to reflect on the history of their families and their community, as well as to understand, interpret and formulate scientific ideas in a variety of situations, including everyday ones. It also allows them to contextualize the relevance of plants over time and their interactions.

In step one, the short story “the power of watercress” will be presented (Chart 2). The story can be printed out or written on the board for the students to read. The approximate duration of this step is 10 minutes.

In step two, in groups, the students can create an illustrated timeline of the watercress story, highlighting the main events and transformations throughout the narrative, lasting approximately 30 minutes.

In step three, there will be a 20-minute guided discussion. First, students will discuss in small groups how watercress was used as a medicine in history, its origin and how it arrived in Brazil, as well as the type of ecosystem in which it is found, according to the text. They will discuss how the selection of plants was important for the acquisition and production of food and the processes of morphological and genetic changes caused by the selection process, based on well-known foods such as corn and rice. They will be able to discuss the medicinal properties of plants and how this may have helped man throughout history. At the end, the students will be assessed on the development of their group work and their participation in the discussions.

4.3.2 Lesson 2 - Medicinal plants: access, safety and efficacy

The general aim of the second lesson is to analyze the pros and cons of using medicinal plants, promoting a discussion about their efficacy and safety. The specific objectives are: to organize a classroom debate on the rational use of medicinal plants; to explore the knowledge and uses of plants in students' daily lives; and to highlight the importance of scientific knowledge about medicinal plants, such as how they are used, their benefits, risks, regulations, scientific evidence, etc. Chart 4 highlights the competences, skills and possible interdisciplinary interaction to develop the theme. To carry out this lesson, the teaching resources used will be: chalkboard, pencil, student notebook, textbook, colored pencils and pen.

Chart 4: Competences and skills developed.

Objetivo de aprendizagem

Analisar os prós e contras do uso de plantas medicinais e promover a discussão sobre sua eficácia e segurança.

Competências e Habilidades desenvolvidas

Ciências da Natureza: competência geral 1, 2, 4 e 9, competência específica 1 e 2 de Ciências da Natureza para o Ensino Fundamental. Habilidade EF07CI09 conteúdo do 7º ano, previsto na BNCC. Revisão das habilidades EF06CI29MG, EF06CI30MG do Currículo do Estado de Minas Gerais.

Sugestão de interdisciplinaridade para esta aula

Língua Portuguesa: habilidades EF69LP14, EF69LP43, EF69LP25, EF69LP30, ambas da BNCC previstas para o 7º ano.

Source: Authors (2023).

The lesson will be divided into two steps. This activity can be integrated with another subject, such as Portuguese.

Step one: divide the class into two groups, one for and one against the use of medicinal plants. Each group should research and list arguments that support their position. Organize a debate in class, in which the groups will present their arguments. Students can ask each other questions to deepen the discussion. The estimated duration is 30 minutes.

Step two: After the debate, conduct a guided discussion (20 minutes) in the classroom to explore the following questions: *Have you used medicinal plants or do you know someone who has? Have your symptoms improved? Have you done any research into the plant used, how to use it and its contraindications?*

Finally, ask the students to carry out a group survey and write a paper on medicinal plants, covering the topics of use, benefits, risks, regulations and scientific evidence. This work should be presented in the next class. The students will be assessed on the development of their group work and their participation in the discussions.

4.3.3 Lesson 3 - Traditional knowledge, ethics and scientific knowledge 1

The general aim of the third lesson is to disseminate information and produce knowledge about medicinal plants in a critical, meaningful, reflective and ethical way, promoting the recovery of and respect for the cultural heritage of medicinal plants enshrined in the community.

The specific objectives of this class are to disseminate information and produce knowledge about medicinal plants in a critical, meaningful, reflective and ethical way, and to create information posters about the role of medicinal plants in health, highlighting their potential benefits, associated risks and challenges.

To achieve these objectives, we propose activities in which students can present their work produced as specified in the previous lesson. And through them, recognize ethics

as a necessary principle in the production of scientific knowledge. The competences, skills and possible interdisciplinary interaction to develop the theme are shown in Chart 5.

Chart 5: Competences and skills developed.

Objetivo de aprendizagem

Disseminar informações e produzir conhecimentos sobre as plantas medicinais de forma crítica, significativa, reflexiva e ética, promovendo o resgate, o respeito pela herança cultural sobre plantas medicinais consagrada pela comunidade.

Competências e Habilidades desenvolvidas

Ciências da Natureza: competência geral 1, 2 e 9, competência específica 1 e 2 de Ciências da Natureza para o Ensino Fundamental. Habilidade EF07CI44MG do Currículo do Estado de Minas Gerais. Revisão das habilidades EF06CI29MG, EF06CI30MG, EF06CI31MG, ambas do ano anterior.

Sugestão de interdisciplinaridade para esta aula

Língua Portuguesa: habilidades EF69LP14, EF69LP25, EF69LP30, EF69LP38, EF69LP42, EF69LP43, EF69LP44, ambas da BNCC previstas para 7º ano.

Source: Authors (2023).

This activity allows for integration with the Portuguese language subject, encouraging students to ask questions and, with the collaboration of their classmates and teachers, develop explanations or arguments on the topic under discussion. The lesson will be organized in two steps:

Step one: the presentation of the work done in the previous lesson. At this point, the students will have to present their work. Organize the groups and ask each team to display their posters in the classroom. Encourage students to ask questions and discuss the information presented. The presentation should last approximately 30 minutes.

Step two: we propose a simulation of an ethical debate, followed by a final reflection and discussion. Present the students with hypothetical scenarios involving the use of medicinal plants, such as a sick child whose parents choose to treat them only with natural remedies or the application of herbal plasters in cases of venomous animal bites.

Ask the same group to discuss the pros and cons of each situation, considering the perspectives and ethical decisions involved. At the end, the students will be assessed on their presentation, the development of their group work and their participation in the discussions. The approximate duration for this discussion is 20 minutes.

4.3.4 Lesson 4 - Influence of climate change on traditional knowledge, biodiversity, ethics and scientific knowledge II

The general aim of the last lesson in the Didactic Sequence is to analyze, understand, assimilate and reflect on the importance of valuing and respecting cultural practices and traditional knowledge associated with the use of medicinal plants, as well as how climate change can affect traditional knowledge.

The specific objectives of this lesson are to analyze the protection of traditional knowledge in Brazil, explore ethical dilemmas related to the use of medicinal plants, highlight how traditional knowledge is associated with biodiversity, encourage appreciation and respect for traditional communities and their culture, and highlight how climate change can affect the ecological knowledge of traditional communities.

The competences, skills and possible interdisciplinary interactions to develop the theme are shown in Chart 5. To carry out this lesson, the teaching resources used will be: chalkboard, pencil, student notebook, colored pencils, pen, medicinal plant species.

Chart 5: Competences and skills developed.

<p>Objetivo de aprendizagem</p> <p>Analisar, compreender, assimilar e refletir sobre a importância da valorização e do respeito às práticas culturais e os conhecimentos tradicionais associados ao uso de plantas medicinais e como as mudanças climáticas podem afetar o conhecimento tradicional.</p>
<p>Competência e Habilidades desenvolvidas</p> <p>Ciências da Natureza: competência geral 1, 2 e 9, competência específica 1e 2 de Ciências da Natureza para o Ensino Fundamental. Habilidades EF07CI06, EF07CI08 previstas na BNCC, da BNCC, previstas para o 7º ano. Habilidades EF07CI35MG, EF07CI42MG, EF07CI43MG, do Currículo do Estado de Minas, ambas previstas para o 7º ano. Revisão das habilidades EF06CI29MG, EF06CI32MG, EF06CI33MG, de Ciências da Natureza, ambas do ano anterior. Pré-requisito para a habilidade EF08CI16, prevista na BNCC.</p>
<p>Sugestão de interdisciplinaridade para esta aula</p> <p>Artes: habilidade EF69AR34B prevista para o 7º ano.</p> <p>Geografia: habilidade EF07GE03 prevista na BNCC, habilidades EF07GE14MG do Currículo de Minas Gerais, ambas referentes ao conteúdo do 7º ano. Revisão das habilidades EF06GE11, EF06GE13, referentes ao ano anterior.</p> <p>História: EF07HI09, EF07HI10, ambas da BNCC previstas para o 7º ano.</p> <p>Língua Portuguesa: habilidades EF69LP14, EF67LP15, ambas da BNCC previstas para o 7º ano.</p>

Source: Authors (2023).

This activity makes it possible to integrate subjects such as Arts, Geography, History and Portuguese Language, encouraging students to reflect, argue and recognize territorialities as the legal rights of native indigenous communities, quilombo remnant communities, forest and cerrado peoples, river dwellers and caiçaras, among other social groups from the countryside and the city. The lesson will be organized in two steps:

Step one: we suggest conducting a preliminary reflection on the topics covered throughout this DS. This reflective approach aims to deepen understanding of the content explored in class. This practice is important for improving the teaching and learning process, as it involves a dynamic and dialectical movement between practice and reflection on that practice. As Freire (2001) points out, this movement enables students to internalize meanings, establishing a connection between previous and new knowledge, thus enriching their understanding of the content presented.

Start the activity by discussing how the search for and use of plants with therapeutic properties is ancient and passed down from generation to generation. One of the biggest challenges today is how to preserve this knowledge. Given this argument, lead a class discussion to explore the following questions: *Is there any protection for traditional knowledge in Brazil? How can we protect traditional knowledge? How do traditional communities contribute to preserving biodiversity? What is the importance of linking traditional and scientific knowledge? When a scientist uses a plant that is known and traditionally used in a community and manages to prove its effectiveness, who should get the credit, the scientist or the population?*

After sharing their opinions and thoughts, they pointed out that when a population becomes extinct, as in the case of the Tanaru Indigenous group, known as “Índio do Buraco”, the last of their group, all the knowledge developed about nature over generations in that community dies with it. To prevent this loss, laws have been created to protect traditional communities and their knowledge. Cite examples of traditionally used plants that have served as a source of research for the production of medicines. Explain that when a scientist uses a traditionally known species and proves its efficacy, the community should take credit for the discovery.

Highlight the occurrence of biopiracy, which involves the misappropriation of plants or other natural resources for profit, without authorization from the people who hold the knowledge or the country of origin, and without due recognition and financial compensation. Stress that it is important to recognize the intellectual right to traditional knowledge. The approximate duration for this discussion is 30 minutes.

Step two: final assessment activity - Creating Awareness Messages. Hold a discussion with the students on the following question: *can climate change affect the traditional knowledge of communities?* If necessary, recall situations previously presented and discussed, so that they can associate the impacts of climate change on traditional knowledge, such as planting, harvesting, productivity, among others.

Finally, in order to build a critical and reflective discussion about medicinal plants, explain that although we know the popular name of medicinal plants, it is important to know the scientific name of these species and to recognize the morphological characteristics and pharmacological properties of each plant before consuming them. This helps to avoid risks, adverse effects on the body, drug interactions and toxicity.

Introduce the students to plant species with “similar” characteristics and ask them to recognize the plants according to the work presented by the groups earlier. This activity aims to deepen students' understanding of the relationship between humans and plants, as well as the importance of preserving species diversity and incorporating traditional knowledge into science and environmental awareness. The activity also encourages critical reflection and the search for solutions to socio-environmental issues. The approximate duration for this discussion is 20 minutes. Students will be assessed on their participation in the discussions.

5 Conclusions

This article details a Didactic Sequence (DS) carefully developed to contribute to teaching and learning in science, promoting the interrelationship between traditional and scientific knowledge. The proposed activities, integrated with an interdisciplinary approach,

have the potential to be a significant pedagogical tool, capable of providing students with a deeper and more contextualized understanding of scientific content.

The methodology developed in the development of the DS included the careful selection of a theoretical-methodological framework, the incorporation of traditional tales, the precise definition of learning objectives and the careful development of activities. This process can offer students the opportunity to question, reflect and construct knowledge in a critical and informed way. The planned lessons made use of various methodologies, such as readings, presentations of ethnobotanical tales, debates and group work, which not only engage students, but can also create a dynamic and interactive learning environment.

This study highlights the importance of approaching science education, especially in the field of botany, using ethnobotanical knowledge as a starting point. This approach not only enriches science teaching, but also extends to other areas of knowledge, reinforcing educational practices that favor environmental sustainability.

Faced with the challenges posed by climate change, incorporating ethnobotanical knowledge into classrooms has emerged as an important strategy not only for teaching science, but also for promoting awareness and sustainable practices, preparing students to face the challenges of the contemporary world and actively contribute to society.

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35

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