REVISTA CIENTÍFICA SISTEMÁTICA

Instrumentation for the contextualized teaching of botany in schools in Latin America and the Caribbean

Divânia Nunes Rodrigues[1]
Evens Clairvil[2]
Erica Duarte-Silva[3]

Crossref doi 10.56238/rcsv14n3-001

ABSTRACT

It is essential that teachers reduce the distance between the student's social context and the content of Biology, governing it in a dynamic way, leading the student to notice that the contents are part of everyday life and that it is possible to understand them, Thus, associating practice with theory. Being a discipline within Biology, Botany is one of its branches of paramount importance, which have as objects of study to assist in other areas of biology. In this context, Plant Morphology, which teaches the parts of plants and their relationships with environmental factors, becomes a facilitator in understanding, when taught in a contextualized way. In view of the above, this project aims to optimize the teaching-learning of the content of Plant Morphology for Elementary School II in the municipality of São Mateus-ES Brazil, through a didactic sequence based on a scientific theoretical framework and in the perspective of Historical-Critical Pedagogy in the teaching of science, expanding beyond the scientific, cultural, economic and social aspects in order to improve both the didactics of teachers, and the students' interest in plants, so that they are able to associate and understand the relationship of Plant Morphology with their social context. The present research is characterized as qualitative bibliography, the data searches were carried out in journals and scientific articles published related to the theme of this study. As a result, it was chosen as a model species for the preparation of a didactic sequence, in this case, the plant species *Persea americana* Mill. (Lauraceae, Basal Angiosperm), commonly known as avocado (Portuguese language), avocat (French language), avocado (Spanish and English language, especially in the USA). It is a species occurring in the municipality of São Mateus-ES, and the island of Guriri. Of native origin of the American continent, it has significant importance in the fight against hunger and malnutrition, cultural, gastronomic, pharmacological, and cosmetic importance The main aspects of Botany Teaching in the courses of: (1) Elementary School Sciences II, (2) High School Biology, (3) Undergraduate in Biological Sciences were contemplated with the avocado as a model species for the contextualized study of Botany. Finally, due to the modifications of the New Common Curriculum Base (BNCC), the present study was adapted for use in Elementary School II in the scope of Basic Education.

Keywords: Avocado, Plant-anatomy, Ethnobotany, Plant-morphology, *Persea americana*.

[1] Licensed Professor. Degree in Biological Sciences at CEUNES-UFES (Federal University of Espírito Santo). Center for Research and Pedagogical Practices in Biology Teaching and Environmental Education (NPPBio).
[2] Degree in Agronomy - Polyvalent University of Haiti (2015). Master's Degree in Tropical Agriculture - UFES (Federal University of Espírito Santo), Brazil, 2021. Certificate in Sustainable Development (Understanding and Managing Human Dimensions, Projects of Change in Sustainable Development) – University of Liège (UL), Belgium, 2022. Doctor student in Applied Botany at the Federal University of Lavras (UFLA), Brazil. Researcher at the Center for Research and Pedagogical Practices in Biology Teaching and Environmental Education (NPPBio).
[3] Doctor in Sciences: Botany from UFRGS (Federal University of Rio Grande do Sul). Professor of the Degree Course in Biological Sciences at CEUNES-UFES. Department of Agricultural and Biological Sciences (DCAB). Center for Research and Pedagogical Practices in Biology Teaching and Environmental Education (NPPBio). Corresponding author: profaericaduartesilva@gmail.com

REVISTA CIENTÍFICA SISTEMÁTICA

INTRODUCTION

Coelho et al. (2020) corroborating what Sobrinho (2009) stated that in order to teach or learn Science and Biology it is essential for the teacher to have the will to instruct the student and the need for this learning must emerge from the teacher and be explicit to the student as something that is useful to him.

This desire makes it pleasant to read, investigate, research, experiment and, thus, by provoking reflection on what is being taught and learned, the opportunity to argue, discuss and question the different points of view on the same fact or issue is provided.

In this context, teacher and students establish an important link for the teaching and learning process and this movement, between learning and teaching, is interspersed between the respective actors, which makes the educational context structurally fundamental, unique and irreplaceable. The teaching process in the area of Natural Sciences, and the research practices are in the guidelines of the BNCC, stating the importance that this investigative dimension of the area should promote the approximation of students with:

> [...] the investigative dimension of the Natural Sciences should be emphasized in High School, bringing students closer to the procedures and instruments of investigation, such as: identifying problems, formulating questions, identifying relevant information or variables, proposing and testing hypotheses, elaborating arguments and explanations, choosing and using measurement instruments, planning and carrying out experimental activities and field research, report, evaluate and communicate conclusions and develop intervention actions, based on the analysis of data and information on the themes of the area. (BRAZIL, 2018).

This work had as its line of research the constructivist idea, that is, when the student participates in his own construction of knowledge, aiming at the interaction of the environment with the object. In this sense, according to Matui (1995) cited by Conceição et al. (2021), Constructivism is a theory that is based on the interaction of the subject (student) with the object (the environment), thus, acting with an interactionist idea, in which the environment is necessary for the cognitive, historical, and social construction of the subject in the world, thus building the knowledge of each being. Scientific research confirms that for several decades, the teaching of Science and Biology in Brazil has followed a path in which the vast majority of classes taught have the textbook and its illustrations as the main teaching-learning instrument (MARTINS, SANTOS and El-HANI, 2012; SANTANA, 2022). Freire (1996) states that an education designed in the context of students, their environment and their culture tends to facilitate the teaching-learning process; Thus, education can transform the student into a being capable of promoting positive changes in their society and in their natural space.

The teaching of Botany contributes to the formation of individuals with skills and attitudes aimed at the conservation of the environment. In this sense, it rescues its values, cultures and

contextualized knowledge. Several local authors work on the teaching of Botany contextualized, from a Freirean perspective, either in a way that focuses on the conservation of the environment (COELHO, DUARTE-SILVA and PIROVANI, 2021; SILVA, TOGNELLA and DUARTE-SILVA, 2018; MENEZES et al. 2017), or related to the contextualization of knowledge (CLAIRVIL et al 2021; CLAIRVIL and Duarte-Silva 2021; CONCEIÇÃO, ALMEIDA and DUARTE-SILVA, 2020; CONCEIÇÃO et al. 2021; PIRES et al. 2020; DUARTE-SILVA et al. 2019; DUARTE-SILVA, MACIEL and SALES, 2014; MACIEL et al. 2014; SOUZA, 2014). Several authors have called attention to the Teaching of Basic Education, especially the teaching of Biology, because in this science it investigates the study of life. On the other hand, there is still a concern about the interest of students in this area, because there is a significant percentage of students who do not have an affinity for this subject. Montenegro (2008) criticizes that science teaching is based on decontextualized books, motivating students to memorize, but without understanding the concepts and applicability of what is studied, that is, unrelated to their daily lives.

It is in this perspective that the present proposal aims at the relevance of a critical reflective teaching, as it can contribute to contextualized teaching and to the acquisition of knowledge, and can also strengthen diversity in cuisine, environmental education on the Island of Guriri-ES.

Krasilchik (2011) states that a biology laboratory goes beyond the school, that is, on beaches, mangroves, forests, where students can expand their knowledge by having contact with animals and plants in their habitat; to collect organisms; interview experienced biologists; to meet new species; and so on. Visiting museums, botanical gardens and zoos are part of the didactic program of biology teachers.

According to Braga et al, (2020) the teaching/learning process will be more efficient when the Botany contents are related to the space, the Biome, and the experiences lived by the student. Thus, it is essential that the contents presented in textbooks can motivate new contextualized experiences, to improve the student's teaching-learning process.

Based on the above assumptions, the following questions arise: - "How does the teaching of Botany influence the learning process of students in elementary school and what is its relationship with everyday life?". "What is the importance of contextualized teaching in Plant Morphology?". As a hypothesis we can mention that the daily life, that is, the socio-environmental context, is a facilitator of the teaching-learning process of VEGETATIVE ORGANS AND PLANT REPRODUCTIVE STRUCTURES IN ELEMENTARY SCHOOL II.

In view of the above, this work aims to use the plants of the student's daily life as an instrument for the teaching of Plant Morphology. The specific objectives were: (1) To use local plants for the teaching of vegetative organs, such as: root, stem and leaf; (2) To highlight in local

plants the reproductive structures for teaching, such as: flower, fruit and seed; (3) Apply in the context of Guriri Island-ES, the specific objectives above, according to a case study on Science Teaching in Brazilian and Haitian schools; (4) Develop a didactic sequence containing the following knowledge of plant morphoanatomy: morphological characteristics of a local model plant, anatomical, basic stem organization, pharmacobotanical and cosmetic use, food and consumption, stem, root, leaf, seed germination, leaf morphoanatomy, embryonic axis anatomy, flower, seed and fruit; (5) To analyze studies that aim at the importance of contextualized teaching, with environmental education as a cross-cutting theme in the theoretical basis.

THEORETICAL FOUNDATION

This work has as theoretical references, Paulo Freire, José Eustáquio Romão, Duarte-Silva and collaborators regarding the works on the teaching of Biology in Haiti. Janyne Soares Braga and, above all, Fernanda Tesch Coelho regarding the contextualization of knowledge at UFES for Basic Education schools in São Mateus.

According to Silva et al. (2016), in the north of the state of Espírito Santo, the didactic resources pointed out as most common by teachers when teaching their Botany classes are blackboard and textbook and few work with different resources such as microscopes, internet and field classes. In this sense, Ursi et al. (2018) corroborating Silva et al. (2016) argued that botany is an area of Biology that does not attract students much, because when teaching this content most teachers choose to use the traditional methodology, memorization and in a decontextualized way, and also the use of complex terms that are not part of the students' vocabulary, making it difficult, resulting in tiring classes, significantly compromising the teaching and learning process.

Braga et al. (2020) argued that in the teaching of Elementary School (PE) Sciences, the students' lack of interest is evident, as the methodologies used are the result of old forms of teaching, directing the student to memorize the topics covered to later make the preparation of activities and assessments. It is important to understand and objectify that teaching is a dynamic process, in which the methodologies used are directly related to learning.

Textbooks need to aim at the role of stimulating critical reflection, investigative sense and the search for new knowledge by students, in this perspective act as a motivation for new experiences, providing the teacher with possibilities to work with various aspects that can improve student learning, relating them to the social context (SILVEIRA and ARAÚJO, 2014). Thus, it is essential to diversify the didactic resources used, as the use of the didactic resource will only have meaning when it constitutes a support element in the construction of students' knowledge (BRAGA et al., 2020).

Corroborating Freitas' (2007) statement, knowledge;

According to Coelho (2020):

> Rosa (2017 apud Coelho, 2020) describes that the textbook has been the most used resource in Science classes in Basic Education. However, for some time now, it has not been the only instrument in our school units, and its use has been articulated in conjunction with other materials and resources, such as anatomical models, science laboratories, multimedia projections and paradidactic books (CHOPPIN, 2004; ECHEVERRÍA, MELLO, GAUCHE, 2010 apud Coelho 2020)

Also according to Coelho (2020)

> For Ramos (2002 apud Coelho 2020) contextualization expands the possibilities of interaction not only between disciplines limited to one area of knowledge, but also between this knowledge and the student's reality. This fact is reinforced in the BNCC (BRASIL, 2018 apud Coelho 2020) and leans from the defense that for the teaching process to be effective, it is essential to have previous problematizations of the content, the linking of the contents to the students' daily lives and the establishment of interdisciplinary relationships that stimulate the reasoning required to obtain solutions to the questions, a fact that makes learning effective.

The National Common Curriculum Base (BNCC) reinforces the importance of understanding the plurality of youth, meeting the expectations of students and the dynamic and diverse demands of society for training in High School (BRASIL, 2018).

> Considering that there are many young people implies organizing a school that welcomes diversity, promoting, intentionally and permanently, respect for the human person and his or her rights. Moreover, it guarantees students to be protagonists of their own schooling process, recognizing them as legitimate interlocutors on curriculum, teaching and learning. In this sense, it means ensuring them an education that, in tune with their paths and histories, allows them to define their life project, both with regard to study and work as well as with regard to choices of healthy, sustainable and ethical lifestyles (BRASIL, 2018, p. 463).

In this perspective, Biology teachers, when teaching their classes, it is vital that the complexity and applicability of scientific concepts and contents are contemplated, enabling critical and contextualized learning that leads to the understanding of basic phenomena of everyday life, improving the ability to make decisions in issues related to science and technology in which they are involved (DEL PINO; FRISON, 2011, COELHO et al., 2020).

Biology presents its real and testable elements, thus enabling the student, when presented with the approach of Science, such as investigation, reflection, critical analysis, creativity, problem-solving based on knowledge, to be involved with the nature of scientific doing, understanding how Science is built over the years COELHO et al., (2020).

According to Braga et al. (2020), contextualization enables healthy debates, critical discussions and exchanges of experiences between student/student and student/teacher during classes, being fundamental in the teaching-learning process. Thus, it is important that science books contemplate the characteristics of the students' regional biome, because it allows the teacher to

contextualize it with the regional biological characteristics and the local environmental problems present in the students' social context.

In this context, Souza et al. (2020) argue:

> Educator and learner change intellectually and qualitatively in relation to their conceptions of the content they have reconstructed, passing from a stage of less scientific understanding to a phase of greater clarity and understanding of this same conception within the totality. There is, therefore, a new positioning in relation to the social practice of the content that was acquired.

The contextualized teaching of biology enables students to develop new relevant knowledge in addition to those they already have, this perspective is being discussed by researchers in the areas of neuroscience, psychology and pedagogy (BRANSFORD et al., 2007). Contextualization makes the teaching and learning process more relevant and creative for students, who are able to connect with what they study (URSI et al., 2018).

In this scientific context, the BNCC (BRASIL, 2018), in the area of Natural Sciences and their Technologies, with regard to the concepts of competencies and skills, the document guides:

> [...] considering the continuity of the Elementary School proposal, its relevance in the teaching of Physics, Chemistry and Biology and its adequacy to High School. In this way, the BNCC in the area of Natural Sciences and its Technologies proposes a deepening of the themes Matter and Energy, Life and Evolution and Earth and Universe. The conceptual knowledge associated with these themes constitutes a basis that allows students to investigate, analyze and discuss problem-situations that emerge from different sociocultural contexts, in addition to understanding and interpreting laws, theories and models, applying them in the resolution of individual, social and environmental problems. In this way, students can re-elaborate their own knowledge related to these themes, as well as recognize the potentialities and limitations of Natural Sciences and their Technologies (BRASIL, 2018, p. 548).

In this sense, contextualized teaching evidences the student's reality not as an initial part of the teaching and learning process, but as the teaching context itself (RODRIGUES, AMARAL, 1996 apud KATO, KAWASAKI, 2011) understanding that knowledge makes sense to the student and that he can appropriate the acquired knowledge, applying it in his life as a citizen. Following an inverse path, teaching that works in a decontextualized way with everyday life devalues the active role of the student in the schooling process, but education directed to valuing the interests of the student, considering the plurality of youth and each individual as a unique being, investing in the training of teaching professionals, promoting the encouragement of production, of valuing and popularizing Science and Technology in the country, ensuring equal access to all, can provide a great advance for the teaching of Science and Biology COELHO et al., (2020).

Teixeira (2003) argues that the teaching of natural sciences and mathematics has been centered on content, memorization of algorithms and terminologies, lack of contextualization and absence of articulation with the other disciplines of the curriculum.

In this sense, to minimize the negative impacts of the decontextualization of Science and Biology textbooks, the contents covered in the classroom, I propose a complementary material for the teaching of Science and Biology, specific for the Teaching of Botany, enabling the interaction of various knowledge, motivated by students, healthy debates and, also, maintaining interdisciplinarity through this didactic material.

In view of what was exposed, I showed that it is of paramount importance to contextualize the teaching of Science and Biology through the use of complementary materials that value the regional flora and seek to facilitate the association of contents by students, aiming at a quality and meaningful teaching. Contextualization brings critical discussions, healthy debates, and important actions in the teaching-learning process during the classes. Throughout this process, it is essential to train them as critical, creative and responsible subjects in order to value their experiences, skills, pluralities of ideas, stories and expectations.

The use of appropriate didactic resources, the contextualization of the contents also act as teaching strategies. Thus, the concepts and terms in the teaching of Botany become more meaningful to students when they are able to relate the content to their personal experiences.

To direct the Science and Biology educator, proposing ideas to innovate teaching, leading to a critical reflection of the current context. In this sense, valuing the previous knowledge of the students, mobilized so that they can perceive some relationship between the content and their daily life, their needs, problems and interests of their community.

It is essential to plan field classes: beaches, mangroves, forests, where students can have the experience of having contact with plants and animals in their natural habitats.

METHODOLOGY

To carry out the research, a qualitative bibliographic methodology was used. According to Ludke & André (1986), qualitative research aims at the natural environment as its primary source of data and the researcher as its main instrument, referencing its values, reinforcing its theoretical stance, that is, the worldview. Thus, qualitative research motivates the researcher's direct contact with the environment and the case being investigated.

PLACE OF STUDY

Guriri Island is located in the north of the state of Espírito Santo, about 30 km from the border with the state of Bahia, and the coast of the extreme south of Bahia. It is a continental island, separated from it by the Cricaré River, whose access by road and bridges is through the municipality of São Mateus-ES. Much of the island's territory belongs to this municipality, including its urban

perimeter. But a small part of the island's riverside territory belongs to the neighboring municipality, Conceição da Barra-ES (Moreira et al., 2018). Guriri, as the São Mateus neighborhood that inhabits the island is called, is the largest seaside resort in the North of Espírito Santo with an estimated population of 14,000 inhabitants and a floating population in the high season of 75 thousand people, in years of great tourist movement, and dates such as the New Year's holiday and Carnival. In general, the island of Guriri encompasses the Orla da Praia, it is an Open Museum of Environmental Education of the TAMAR Project. In 2016, it was deactivated due to financial conditions and change of executive administration, leaving the environmental monitoring activities on Guriri beach.

SPECIES STUDIED

Avocado, species *Persea americana* (Lauraceae), basal angiosperm. The collection of botanical material: The botanical material will be purchased at the open market on the island of Guriri, and extracted from trees that make up the backyards and streets of Guriri Island, always with permission from the owner of the property. The survey began in November 2021 and is expected to end in February 2023.

METHODOLOGICAL PATHS

To carry out the research, a qualitative bibliographic methodology will be used. Maciel et al. (2014) aimed to develop low-cost science teaching practices applicable in both Brazil and Haiti, with the common cuisine of these two countries as a motivating theme. To get to know Haitian cuisine, an ethnographic work was developed through literature review, document analysis and fieldwork (MACIEL et al., 2014). The data from the ethnographic research were presented to students of the Teaching Degree in Biological Sciences and the undergraduates were motivated to develop teaching practices of low or no cost, from these culinary elements (MACIEL et al., 2014). The practices elaborated use the socio-environmental context of the students for the teaching of Science, such as domesticated plants and animals present in markets and rural areas, and didactic models were elaborated with reused solid waste (MACIEL et al., 2014). In the present work, we will use the methodology of Maciel et al. (2014) applied in the aforementioned study with a focus on Haiti in the Island of Guriri-ES, Brazil. As a model plant, the avocado was chosen, which, although it is an exotic species, is highly nutritional, dialoguing with the fight against hunger and malnutrition; abundant in our region, and the history of implementation dialogues with the history of Brazil and the Great Navigations. Finally, avocado is a species of avocado that is widely consumed in Haiti, the Caribbean, and Mexico. For the study of the theory of Plant Morphology and Anatomy, the works of Almeida and Almeida (2014) and Oliveira et al (2010) were used.

THEORETICAL-METHODOLOGICAL FRAMEWORK

This work consists of a case study whose methodology used was ethnographic work, according to the theoretical-methodological assumptions of André (2020). They are short-term works, carried out by non-anthropologists, or professionals from other areas of science. They do not have an ethnographic purpose in themselves, but are carried out in order to seek answers for the specific areas of the researchers in question. The ethnography of school practice was used in the present work for the purpose of solving problems in teaching practice, and subsidies for Environmental Education, Ethnobiology and Botany Teaching. The methods used in the research were: scientific literature review, fieldwork and document analysis (André, 2020). "A work can be characterized as ethnographic in education, when it makes use of the techniques that are traditionally associated with ethnography, that is, participant observation, intensive interviews, and document analysis. The researcher approaches people, situations, places, events, maintaining direct and prolonged contact with them. How does this contact take place? First, there is no intention of changing the environment, introducing modifications that will be experimentally controlled as in experimental research. Events, people, situations are observed in their natural manifestation, which makes such research also known as naturalistic or naturalistic" (André, 2020).

RESULTS AND DISCUSSION

Maciel et al. (2014) aimed to develop low-cost science teaching practices applicable in both Brazil and Haiti, with the common cuisine of these two countries as a motivating theme. To get to know Haitian cuisine, an ethnographic work was developed through literature review, document analysis and fieldwork (MACIEL et al., 2014). The data from the ethnographic research were presented to students of the Teaching Degree in Biological Sciences and the undergraduates were motivated to develop teaching practices of low or no cost, from these culinary elements (MACIEL et al., 2014). The practices elaborated use the socio-environmental context of the students for the teaching of Science, such as domesticated plants and animals present in markets and rural areas, and didactic models were elaborated with reused solid waste (MACIEL et al., 2014).

In the present work, we will use the methodology of Maciel et al. (2014) applied in the aforementioned study with a focus on Haiti in the Island of Guriri-ES, Brazil.

As a model plant, the Avocado was selected, a fruit with high nutritional value, dialoguing with the fight against hunger and malnutrition. Abundant in our region, the history of avocado implantation dialogues and is a reference with the history of Brazil and the Great Navigations. Finally, a particular species of avocado, avocado, is widely consumed in Haiti, the Caribbean, Colombia, and Mexico.

Based on this, a didactic sequence of plant morphology was elaborated with the avocado as the model plant and the Island of Guriri as the context and target audience of the teaching practice.

DIDACTIC SEQUENCE

The knowledge covered in the didactic sequence were;

Consumption of avocado in food:

Avocado is consumed in different ways. In cooking, it can be used to prepare salads, sweets, ice cream, popsicles, sauces and other dishes, in addition to being consumed in its natural form (SALGADO, 2007). In Mexico it is quite common to use it in guacamole; in Haiti, it is widely consumed, and the variety in the country is the avocado (small avocado) (DUARTE-SILVA et al., 2019). Meanwhile, in Brazil it is customary to beat the fruit with milk and sugar and serve it as a dessert. So that the avocado can be consumed whole, the seed is used in food in a crushed form, being efficient for the treatment of dysentery and kidney problems (popular knowledge). Avocado leaves can also be consumed (popular knowledge). And avocado is also used for: avocado pulp is used in the preparation of oils used in cosmetics and in the pharmaceutical area; from the seed is extracted ink; the leaves, fruit bark, tree bark and pits are used in folk medicine (SALGADO, 2007).

Ferreira et al. (2015) ponders that;

> Tango et al., (2004) for the physical and chemical characterization of avocado found that, on average, 53.4% of the predominant lipid composition of the fruit pulp is composed of oleic acid, and can play an important role in the adjuvant treatment of dyslipidemia, and also, that they are regulators of the expression of genes involved in lipid metabolism, thus causing their decrease (FERREIRA, 2015).

The consumption of avocado brings several benefits to people, such as the fight against cardiovascular diseases, both when consumed in food and in pharmaceutical products and cosmetics (SALGADO, 2007).

Pharmacological and cosmetic industry

The antioxidants present in the fruit protect the aging of skin cells, leaving it more hydrated, healthy and beautiful. In addition, avocado helps fight wrinkles, stretch marks and cellulite, due to the large amount of vitamin C that helps in the production of collagen. When used in hair products, avocado helps moisturize them, giving them more shine and softness. As it contains omega 3, avocado helps in memory, improves concentration and also helps in stimulating blood circulation in the brain. The fruit has a large amount of fiber and fatty acids. Thus, it helps control and prevent heart disease as it reduces bad cholesterol and increases good cholesterol. Its consumption also

favors heart health, as there are minerals and antioxidants in the fruit that improve blood circulation. The consumption of avocado is very good for those who practice physical exercise, because if consumed before training it helps with hypertrophy, its consumption helps to avoid muscle fatigue, fighting free radicals that appear when exercise is more intense.

Morphological and anatomical characteristics of vegetative organs

Taxonomia

It belongs to the large clade of Basal Angiosperms (APG, 2009; JUDD, 2007). The avocado is a fruit of the tree called avocado tree and this can reach from 7 to 20 meters in height. It is a tree considered very valuable and is very common in Brazil, in addition to occurring throughout the Neotropical region (from Mexico to South America). It can occur in warm regions of the subtropics, but it is a tropical species (DUARTE-SILVA et al. 2019) The avocado is a pear-shaped fruit, with a light green, dark or reddish skin. Inside, the flesh is a little yellowish-green and there is a single large seed. It is a fruit with plenty of vitamins and proteins, phosphorus, sugar and fat, research reveals that the fat present in the fruit is unsaturated, being a healthy fat, similar to olive oil (OLIVEIRA et al, 2010).

Stem

The avocado seed has a single embryo, but with the occurrence of polycaulia from a single embryonic axis (OLIVEIRA, 2010).

Seedling development and root, stem and leaf formation

The primary root is long and white in color, and the secondary roots are short and filiform; the cotyledons are massive and pinkish in color; the germination of the avocado tree is hypogeal and begins with the formation of a whitish and long primary root; next, the secondary roots, shorter and filiform; the hypocotyl is reduced and the cotyledons are reserve, hypogeal, massive, free, fleshy and hard in consistency; the epicotyls, which form the caulicles in polycaulia, are long, erect, cylindrical, robust and purplish; the plumule is greenish and conspicuous, initiating the growth of simple, petiolate, alternate primary leaves with elliptical limbus, smooth margin and feathered reticulated venation; along with the expansion of the first aeophiles, there is the beginning of the development of the second pair of leaves (OLIVEIRA et al, 2010).

In view of the research carried out in a virtual environment and articles, the anatomy of the root itself of the avocado was not found, but because it is from the angiosperm group.

Morphology and anatomy of the avocado leaf

According to Martinez and Medri (1985), the cross-section of the leaf of *Persea americana* (avocado) has a monostratified epidermis; cuticle optically flat transversely and thick on the leaves located in the upper strata; cortical parenchymal cells are relatively larger than those of other tissues, and those in the deeper layers are two to three times larger than epidermal cells; At the level of the petiole, the xylem and phloem do not form continuous vessels, that is, the xylem and phloem are thin, tiny, of small caliber.

In terms of micromorphology, the epidermal cells of the tree's upper leaves are notably larger; no stomata are observed in the upper epidermis of the leaf in any of the strata, only in the lower epidermis (MARTINEZ AND MEDRI, 1985).

Anatomy of the embryonic axis

The vascular bundles start from a single embryo, which contains all the tissues of the adult plant, in this sense, with the branching of the epicotyl evidencing polycaulia (OLIVEIRA et al, 2010).

Flower

Determinate or auxiliary and apparently indeterminate inflorescences; bisexual or unisexual flowers (in this case, dioecious plants), radical, with a clearly concave receptacle, usually small, white, greenish or yellowish; sepals, usually 6, free or slightly connate, imbricated; Stamens usually 3-12; fillets often with basal pairs of glands (staminodes) that secrete nectar or perfumes; the three innermost stamens are often also modified in this type of staminodes; anthers opening by 2 or 4 valves that curve from the base upwards and expose sticky, often dimorphic pollen; pollen grains without openings and exina reduced to small spines; a carpel; super ovary; placentation +or - apical; 1 stigma, capitate, truncated, lobed or elongated; an egg; drupe fruit or rarely uniseminate berry, usually associated with the fleshy or woody and persistent receptacle (sometimes also with the tepals), often found in color with the fruit; large embryo, with fleshy cotyledons; absent endosperm (APG, 2009; JUDD, 2007).

The flowers of the avocado tree are grouped in inflorescences (panicles) located in the terminal area of the branches. The set of inflorescences of each branch can have hundreds of flowers, although the number varies, depending on the cultivar and the age of the branch. A tree can produce more than a million hermaphrodite flowers, its color is between pale green and yellow, which makes it confusing with the stems and leaves. Flower morphology are regular and trimerous. The perianth is composed of an external whorl with three sepals and an internal one with three identical petals. The

androceum is composed of three whorls with three stamens each and an internal whorl with 3 staminodes. Each flower has a pistil, with a single ovary and its stylet and stigma.

In view of the research carried out in a virtual environment and articles, the anatomy of the flower itself of the avocado was not found, but because it is from the angiosperm group.

Seed and fruit germination

The seeds are monoembryonic and exalbuminous, germination is hypogeal and seedling emergence occurs on average 33 days after sowing. The avocado seed is large, 5 cm long on average, ovoid-shaped, brown in color, protected by an integument. The seed can germinate on the fruits, when they are still attached to the plant. Rarely will the embryo develop leaves, but radicles sprout from the seed and pass through the pulp, in some cases breaking through the shell. The embryo is axial, and the embryonic axis is linear. The two cotyledons are large, oval in shape, pink and hard in consistency (OLIVEIRA et al, 2010).

The avocado tree has fruit with a slender epicarp, fleshy mesocarp and papyraceous and slender endocarp, adhered to the seed coat, monospermic, characterizing a berry, whose shape can be piriform, spherical, elliptical or oval. The pulp (mesocarp) is yellowish, buttery, smooth and almost tasteless (OLIVEIRA et al, 2010).

FINAL CONSIDERATIONS

Plant Morphology scientifically explains many facts of the daily life of educators and students, favoring dialogue between both sides in the teaching-learning process.

In view of the above, the school environment is conducive to the construction and exchange of knowledge, with the use of the appropriate tools in the process of teaching and learning about Botany, which can be propagated more effectively, aiming to reach a greater number of students.

Based on the contents analyzed here, it was found that the general objective of this research was achieved. In the theoretical framework, the first results were described aiming at the importance of plant morphology and anatomy according to the opinion of several authors in the area. In the results and discussions, a didactic sequence was presented proposing how it can contribute to the teaching process. Several studies point to contextualized teaching as a facilitator in the learning process.

In this context, Freire (1996) states that an education designed in the context of students, their environment and their culture tends to facilitate the teaching-learning process. Thus, education can transform the student into a being capable of promoting positive changes in their society and in their natural space.

It is hoped that this research can contribute to the optimization of didactics and teaching practice regarding the teaching and learning of Biology, especially in the area of Plant Morphology for Elementary School II in the municipality of São Mateus-ES, Brazil.

REFERENCES

Almeida, M. de, & Almeida, C. V. de. (2014). Morfologia do caule de plantas com sementes.

Alto Astral. (2017). Abacate: benefícios à saúde. Retrieved December 4, 2022, from https://www.altoastral.com.br/estilo-de-vida/abacate-beneficios-saude/

Angiosperm Phylogeny Group III [APG III]. (2009). An update of the Angiosperm Phylogeny Group classification for the orders and families of flowering plants: APG III. Botanical Journal of the Linnean Society, 161(1), 105–121.

Brasil. Ministério da Educação. (2018). Base Nacional Comum Curricular. Brasília, DF: Author. Retrieved May 27, 2022, from http://basenacionalcomum.mec.gov.br/images/BNCC_EI_EF_110518_versaofinal_site.pdf

Clairvil, E., Maciel, T. S., Almeida, P. S., & Duarte-Silva, E. (2021). Pratiques d'enseignement en biologie impliquant des liens culturels au Brésil avec les Caraïbes. Etudes Caribeennes, 50, 1-9.

Clairvil, E., & Duarte-Silva, E. (2021). Liens socio-culturels et éducationnels entre le Brésil et les Caraïbes (1st ed.). Chisinau, Republic of Moldova: Éditions universitaires européennes.

Coelho, F. T., Duarte-Silva, E., & Castro Monteiro Pirovani, J. (2021). O ensino médio vai à Universidade: (re)conhecendo a biologia através da experiência científica. Revista Kiri-Kerê - Pesquisa em Ensino, 10, 242.

Conceição, L. de O., Vasconcelos, F. F. R., Duarte-Silva, E., Furieri, K. S., & Aoyama, E. M. (2021). Baralho da horta: uma proposta de jogo didático para Educação do Campo. Revista Insignare Scientia - RIS, 4, 238-252.

Conceição, J. R., Almeida, T. R. R., & Duarte-Silva, E. (2020). Práticas de educação ambiental nas comunidades tradicionais e escolares do entorno do Parque Estadual de Itaúnas - Conceição da Barra-ES, no período de 2005 a 2015. Educação Ambiental em Ação, SetNov2020, 1-13.

Duarte, A. (2018). Alguns aspectos da floração e vingamento do abacate. Retrieved August 8, 2022, from http://www.avocadosource.com/international/portugal_papers/DuarteAmilcar2018.pdf

Duarte-Silva, E., Maciel, T. S., Sales, P. A., & Almeida, P. S. (2014). Práticas de ensino em biologia envolvendo conexões culturais do Brasil com o Caribe. In IX Congreso Internacional de Educación Superior - UNIVERSIDAD 2014 (p. artigo 58). La Havana, Cuba: IX Congreso Internacional de Educación Superior - UNIVERSIDAD 2014.

Duarte-Silva, E., Souza, W. O., Machado, J. O., Tesch, F., & Furieri, K. S. (2016). Recursos didáticos utilizados pelos professores de Ciências e Biologia e orientações de prática de ensino a baixo custo na ilha de Guriri, São Mateus-ES, Brasil. In A. T. S. Alfaro & D. G. Trojan (Eds.), Descobertas das ciências agrárias e ambientais (pp. 104-116). Curitiba, PR: Atena Editora.

Duarte-Silva, E., Conceição, J., Aliprandi, T., Lagass Pereira, L., Silvério, A., & Altoé, J. (2020). Ensino de botânica EAD e extensão do projeto Haiti em tempos de novo coronavírus (COVID-19, SARS-CoV-2). https://doi.org/10.22533/at.ed.68520100816

Duarte-Silva, E., Sales, P. A., Silvério, A., & Furieri, K. S. (2019). Alimentação no Haiti: subsídio para educação intercultural em escolas latinoamericanas. In T. A. Rodrigues & J. L. Neto (Eds.), Competência técnica e responsabilidade social e ambiental nas ciências agrárias (pp. 71-77). Ponta Grossa, PR: Atena.

Coelho, F., T., Duarte-Silva, E., & Monteiro, J. (2020). Percepção de estudantes do ensino médio de uma escola pública do Espírito Santo sobre o ensino de Biologia: desejos e realidades. Olhares & Trilhas, 22, 381-402.

Ferreira, A. L., et al. (2015). Consumo de abacate e prevenção de dislipidemias. In V Encontro Internacional de Iniciação Científica - ENIC (p. 40).

Freire, P. (1996). Pedagogia da autonomia: Saberes necessários à prática educativa. Paz e Terra.

Judd, W. S., Campbell, C. S., Kellogg, E. A., Stevens, P. F., & Donoghue, M. J. (2007). Sistemática vegetal: Um enfoque filogenético (3rd ed.). Artmed.

Helder. (2022). A lição do abacateiro. Retrieved November 3, 2022, from https://irdp.com.br/reflexoes/a-licao-do-abacateiro/

Krasilchik, M. (2011). Prática de ensino de biologia. Editora da Universidade de São Paulo.

Maciel, T. S., Souza, A. F. C., Cruz, J. J., Aguiar, V. R., Sales, P. A., Margiero, K. P. F., ... & Duarte-Silva, E. (2014). Práticas de ensino em ciências de baixo custo destinadas a escolas brasileiras e haitianas. Anais do IV Encontro Nacional de Ensino de Ciências da Saúde e do Ambiente, IV, 1-12.

Martins, L., Santos, G. S., & El Hani, C. N. (2012). Abordagens de saúde em um livro didático de Biologia largamente utilizado no Ensino Médio brasileiro. Investigações em Ensino de Ciências, 17(11), 249-283. Retrieved from http://www.if.ufrgs.br/ienci/artigos/Artigo_ID292/v17_n1_a2012.pdf

Menezes, L. F. T., Aoyama, E. M., Teixeira, M. C., Duarte-Silva, E., & Pereira, O. J. (2017). Herbário SAMES: Conectando pessoas à biodiversidade. UNISANTA BIOSCIENCE, 6, 156-161.

Montenegro, P. (2008). Peregrino, letramento científico: O despertar do conhecimento das Ciências desde os anos iniciais do Ensino Fundamental. Dissertação de Mestrado, Universidade de Brasília.

Mundo Ecologia. (2022). Tudo sobre o abacate: características, nomes científicos e fotos. Retrieved November 3, 2022, from https://www.mundoecologia.com.br/plantas/tudo-sobre-o-abacate-caracteristicas-nome-cientifico-e-fotos/

Oliveira, I. V. M., Costa, R. S., Môro, F. V., Martins, A. B. G., & Silva, R. R. S. (2010). Caracterização morfológica do fruto, da semente e desenvolvimento pós-seminal do abacateiro. UEP, Jaboticabal, SP, Brasil, 69-73.

Planejativo. (2022). Morfologia vegetal: Flor, fruto e semente. Retrieved August 8, 2022, from https://app.planejativo.com/ver-aula/424/material-de-apoio/resumo/biologia-3/morfologia-vegetal-flor-semente-e-fruto

Pires, J. S. B., Furieri, K. S., Coelho, F. T., Magevski, L. da S., Maciel, H. P., & Silva, E. D. (2020). Os desafios docentes no ensino de ciências: Desenvolvimento de um material paradidático contextualizado para o ensino de botânica na Ilha de Guriri-ES, Bioma Mata Atlântica. In R. R. S. da Silva-Matos, J. R. A. Macedo, & G. M. M. de Souza (Eds.), Conservação da biodiversidade e desenvolvimento socioambiental (pp. 80-92). Ponta Grossa, PR: Atena Editora.

Rodrigues, A., Amano, E., & Almeida, S. (2015). Anatomia-Vegetal. Editora da Universidade Santa Catarina.

Salgado, J. M., Danieli, F., Regitano-D'Arce, M. A. B., Frias, A., & Mansi, D. N. (2008). O óleo do abacate (Persea americana Mill) como matéria-prima para a indústria alimentícia. Food Science and Technology, 28(suppl).

Silva, A. C., & Tognella, M. (2018). Mapas conceituais: Conhecimento empírico e acadêmico para o ecossistema manguezal. Revista Guará, 6, 99.

Silveira, M. L., & Araújo, M. F. F. (2014). O papel do livro didático de biologia na opinião de professores em formação: Implicações sobre a escolha e avaliação. Revista de Ensino de Biologia da Associação Brasileira de Ensino de Biologia (SBEnBio), 7, 5594-5605.

Souza, A. F. C., Duarte-Silva, E., & Gonçalves, E. (2020). Instrumentação para o ensino de biologia no ensino médio: Experimentação em fisiologia vegetal. EDUFES.

Teixeira, P. M. M. (2003). A educação científica sob a perspectiva da Pedagogia Histórico-Crítica e do movimento C.T.S. no ensino de ciências. Ciência & Educação, 9(2), 177-190.

URSI, S., Barbosa, P. P., Sano, P. T., & Berchez, F. A. S. (2018). Ensino de botânica: Conhecimento e encantamento na educação científica. Estudos Avançados, 32(94).