Fronteiras: Journal of Social, Technological, and Environmental Science
http://periodicos.unievangelica.edu.br/fronteiras/
ISSN 2238-8869

Article

Planting Knowledge: A Journey Through Plant Nomenclature in Elementary School

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RESUMO

Este estudo investiga a eficácia de uma sequência didática no ensino de botânica para alunos do 7º ano do Ensino Fundamental. O objetivo é promover o conhecimento da nomenclatura botânica e das características distintivas de cada grupo de plantas. A abordagem interventiva inclui rodas de conversa para favorecer o diálogo e o papel ativo dos alunos, além da aplicação do conhecimento em visitas de campo. Os alunos realizaram ilustrações características de cada grupo de planta e colaboraram na produção de um e-book, enriquecendo o processo educativo. A vivência direta com as plantas no ambiente escolar foi fundamental para facilitar a aprendizagem, destacando a importância do contato dos alunos com o objeto de estudo. A autoavaliação revelou maturidade e conscientização sobre a responsabilidade no processo de aprendizagem, ressaltando a importância de envolvê-los ativamente na construção do conhecimento. A sequência didática estimulou a interação dos alunos com as plantas, resultando em uma experiência enriquecedora de aprendizagem.
Palavras-chave: ensino; botânica; grupo de plantas; visita de campo; sequência didática.

ABSTRACT

This study investigates the effectiveness of a didactic sequence in teaching botany to 7th grade elementary school students. The objective is to promote knowledge of botanical nomenclature and the distinctive characteristics of each plant group. The intervention approach includes conversation circles to encourage dialogue and the active role of students, in addition to the application of knowledge during field visits. The students created characteristic illustrations of each plant group and collaborated in the production of an e-book, enriching the educational process. Direct experience with plants in the school environment was fundamental to facilitate learning, highlighting the importance of students' contact with the object of study. The self-assessment revealed maturity and awareness of responsibility in the learning process, highlighting the importance of actively involving them in the construction of knowledge. The didactic sequence encouraged students to interact with plants, resulting in an enriching learning experience.
Keywords: teaching; botany; plant groups; field trips; didactic sequence.

Introduction

Practical activities are fundamental to promote student protagonism in the learning process, since they enable the concrete application of the theoretical knowledge acquired (Cairus 2020). These activities stimulate various skills by allowing students to experience the concepts learned in practice, constituting essential pedagogical strategies for the consolidation of learning.

Submission: June 2, 2025 Accepted: November 6, 2025 Publication: 19/12/2025

v.14, n.4, 2025 • p. 1-15. • DOI http://dx.doi.org/10.21664/2238-8869.2025v14i4.8026

By exploring our natural environment, we can identify the presence of countless plant species, which are fundamental to the life cycle and extremely important for various species. However, even though plants are part of our daily lives in many ways, there is little contact, knowledge, and reflection on the role of these organisms for life on the planet (L. N. B. da Silva et al. 2023). When we are immersed in a planet with a diversity of plant life and fail to perceive this diversity in the environment, the phenomenon of botanical imperception occurs. To break this barrier, it is necessary to consider educational methodologies that guide environmental preservation (Josefe 2023).

This research proposes a didactic sequence for teaching botany, aiming to bring students closer to the world of plants. The main objective is to develop activities that allow students not only to learn about plants but also to become actively and practically involved with them. This includes encouraging direct contact with the natural environment, conducting activities outside the classroom, group dynamics, and an integrated approach that enables students to recognize the nomenclature and morphology of plants. Through this intervention research, the aim is not only to transmit knowledge but also to promote a deeper understanding of the importance of plants in our ecosystem, stimulating the development of meaningful and lasting knowledge.

Furthermore, the crucial importance of morphological knowledge of plants is recognized, since the researcher, upon entering university, realized the absence of this knowledge in her previous education. This gap sparked a desire to promote more complete and meaningful learning among students, aiming not only to fill a knowledge gap but also to overcome social inequalities, especially with regard to disparities in access to knowledge.

Theoretical Framework

Within the field of plant studies is the discipline of botany, which is dedicated to the study of the anatomical, physiological, and morphological characteristics of plants (Batista and Araújo, 2017). Learning the content of botany enables the expansion of learners' cultural and conceptual repertoire, making them more capable of making thoughtful decisions and critically analyzing everyday situations, forming reflective citizens who are able to promote conscious actions to change the reality in which they live (Ursi et al. 2018).

Flaviano (2023) suggests that a promising approach to reducing botanical imperceptibility among students is the use of teaching sequences (TS). These tools aim to bring students closer to plants and take into account the diversity of students in a class, contributing to the learning of scientific knowledge within the content of botany. In addition, the use of various tools promotes dialogue between teacher and student and among students, encouraging discussions, exchanges of knowledge, and the strengthening of bonds.

A study conducted by Santos et al. (2023) on the teaching of botany revealed that students performed poorly on an assessment administered before participating in a practical activity. The data indicate that the knowledge acquired was limited by the absence of activities that brought them directly into contact with the subject matter. After the practical activity, a significant increase in knowledge assimilation was observed. These results suggest that students' difficulty in mastering the content is related to the methodology used in the classroom, highlighting the importance of practical activities for the effective acquisition of knowledge.

Lima and Antunes (2022) emphasize that, within a methodological program, it is essential to link the knowledge acquired in the classroom to the students' daily lives. In the study of plants, this connection can be promoted by encouraging students to observe plants in their community and bring specimens to the classroom, allowing for more in-depth discussions. In this way, students are able to relate their reality to the content studied. In addition, it is crucial to bring problematic issues to the classroom, allowing students to understand the importance of plants for sustaining life.

Silva, Farias, and Muhle (2024) argue that the use of field trips in botany teaching provides an approach that integrates human, social, and environmental dimensions, contributing positively to the socio-educational process. Although they face historical challenges of devaluation, such as scarcity of resources and public policies, field trips are defended as essential for effective teaching. To make them viable, the authors suggest careful planning, financial investments, and well-defined and monitored actions before, during, and after the activities.

Santos and Alves (2021) emphasize that it is necessary to break with the purely bookish and verbal nature of education, which limits the scientific rigor and practical experience that students should have with the environment. They argue that schools should promote a comprehensive education of the individual, empowering students to intervene in environmental issues and overcoming capitalist education that perpetuates social inequalities. In the face of global environmental challenges, authors suggest the need for a change in attitude in the relationship between humans and nature, with a focus on the development of environmental awareness and sustainable pedagogical practices (Colagrande et al. 2021).

According to Silva (Silva 2024), breaking with the society/nature dualism and establishing a more integrated understanding between the different elements that make up the various environments is essential to promote political changes aimed at environmental preservation and sustainability. In the context of science teaching and environmental education, this integrated view reinforces the need for a more conscious and responsible approach to the socio-environmental crises we face.

Methodology

The teaching sequence (Table 1) was planned and applied in a class of 30 seventh-grade students at a public school. However, a total of 27 students actively participated in all the proposed activities.

Results And Discussion

Roundtable discussion to raise awareness about participation in the project

The project was presented to the students with the aim of raising their awareness of participation in all stages of the activity. The presentation was conducted in the form of a conversation circle (Figure 1), seeking to inform students about the purpose of the project and ask them about their contributions.

Figure 1 – Discussion circle to raise student awareness of project participation. Source: authors (2023).

The evaluation was carried out through the students' statements and participation. The main objective of the roundtable discussion is to develop critical thinking and argumentation skills, which has been proven to be an effective resource in research. This approach significantly increased the level of dialogue among participants in the educational process (Silva 2012).

On this special occasion, after the presentation of the project, the following questions were asked: "How do you feel about the project?" and "What do you think this project can enrich you?" The importance of participating in the project to enrich knowledge was discussed with the students.

After explaining the purpose of the project to the students, they were asked, "How do you feel about the project?" The students showed enthusiasm for the project because it involved a field trip, i.e., leaving school is a factor that motivates students. Leaving the classroom to visit a place that students do not normally go to or are unfamiliar with is a factor that stimulates them (Santos 2023). In addition, many showed interest in the subject because they realized that they were unfamiliar with it and could acquire new knowledge.

A new question was raised in the discussion circle: "What do you think the project can enrich you with?" In the second question, the students demonstrated their understanding of the importance of the project for acquiring knowledge and new experiences. During the conversation circle, an effort was made to sensitize students to understand the importance of participating in the project. It is a basic tool for dialogue, encouraging students to speak. By allowing students to express their ideas, the teacher can identify the multiple meanings that these students have of the world and everything around them, promoting the understanding of ideas and the construction of knowledge. Including students in a conversation circle can contribute to the formation of critical, participatory, and autonomous individuals. During the conversation circle, it was found that student engagement in the project was intensified by the opportunity to acquire new knowledge and by the inclusion of a field trip in the planned teaching sequence. Carrying out activities outside the traditional classroom environment, especially in places that students do not normally frequent or are unfamiliar with, proved to be a significant factor in stimulating student interest and participation (Santos, 2023).

Table 1 - Teaching sequence for botany in elementary school (continued).

Source: authors (2023).

Stages	Action plan	Goal	Assessment	Duration
Awareness raising: presentation of the project to students	Organize a roundtable discussion to explain the project	Clarify any doubts and questions about the project and engage them	Diagnostics (roundtable discussion).	One class.
Theoretical class on plant groups and cladogram.	Teach classes using an expository and dialogical approach, using visual aids and questions to explore the concepts of the main plant groups and their evolutionary and environmental characteristics. Present a cladogram: its characteristics and function.	Teach clearly and didactically the differences between bryophytes, pteridophytes, gymnosperms, and angiosperms, highlighting their distinct morphological characteristics, evolutionary nature, and environmental importance. Explain a cladogram.	Formative (Production of cladogram).	Four classes.
Feedback on the cladogram produced by the students.	Organize a roundtable discussion to discuss the cladograms produced.	Explain the correct construction of a cladogram.	Formative (Conversation circle).	One class.
Application of knowledge in the school environment.	Take students to the schoolyard to find plants that have been previously listed and classify them	Provide opportunities for recognizing and classifying groups of plants present in the school environment	Summative (Data tabulation)	One class.
Feedback on the activity carried out in the schoolyard	Organize a discussion circle to clarify doubts, correct the activity, and deepen understanding of the subject.	Promote the exchange of experiences and knowledge in order to enable reflection on the activity carried out. Encourage collaboration and teamwork.	Formative (Discussion circle).	One class.

Table 1 - Teaching sequence for botany in elementary school.

Source: authors (2023).

Stages	Action plan	Goal	Assessment	Duration
Application of knowledge outside the school environment.	Instruct students to observe, photograph, and draw plants from the four groups studied, found in parks, gardens, homes, squares, etc. Share their findings with the class the following week.	Promote the observation and classification of plants outside the school environment, stimulating curiosity and appreciation of biodiversity.	Summative (extra-curricular activity).	One week
Presentation of the material produced by the students.	Instruct students to present their drawings to the class, classifying the plants into groups.	Share the drawings produced and discuss the classification made. Encourage constructive debate.	Formative (oral presentation).	Two classes.
Production of an e-book on plant classification.	Hold a roundtable discussion to propose the production of an e-book to students and discuss the construction of the material.	Mediate students in the creation of the illustrative e-book.	Formative (Discussion group).	One class.
Technical visit to the city's Ecological Park.	Conduct a technical visit so that students can observe and understand the importance of plants.	Help students become familiar with the main groups of plants.	Formative (Report).	4 hours.
Presentation of the knowledge acquired by students at the Park to the school community.	Monitor the production of a mural about the visit to the city's Ecological Park and display it within the school environment.	Dissemination of knowledge acquired during the visit, in order to inform and raise awareness among the school community about the teaching of botany.	Summative (Production of the mural).	Four classes.
Culmination	Hold a discussion circle and evaluate the positive and negative points of the project.	Identify possible improvements for the project.	Diagnostic (Discussion circle).	One class.

Evaluation of the theoretical class: production and justification of the cladogram created by the groups

The theoretical class was organized according to Krasilchik's principles(2004) , which highlight the importance of lectures to convey concepts, emphasize relevant aspects, and stimulate students. To capture the students' attention, resources such as interactive discussions, voice variation, and audiovisual resources, including a PowerPoint presentation, were used. The visual presentation contained representative images of plants, promoting reflection on the students' prior knowledge. Each group of plants was addressed separately, focusing on identifying and understanding their environmental importance. At the end of the class, the concept of cladogram was introduced, explaining its characteristics and function for the evolutionary discussion of plant groups. The formative assessment asked groups of five students to discuss the evolution of plants, placing taxa on an incomplete cladogram and justifying their choices orally (Figure 2). Six groups were formed, and the assessment focused on the correctness of the placement and the justifications presented.

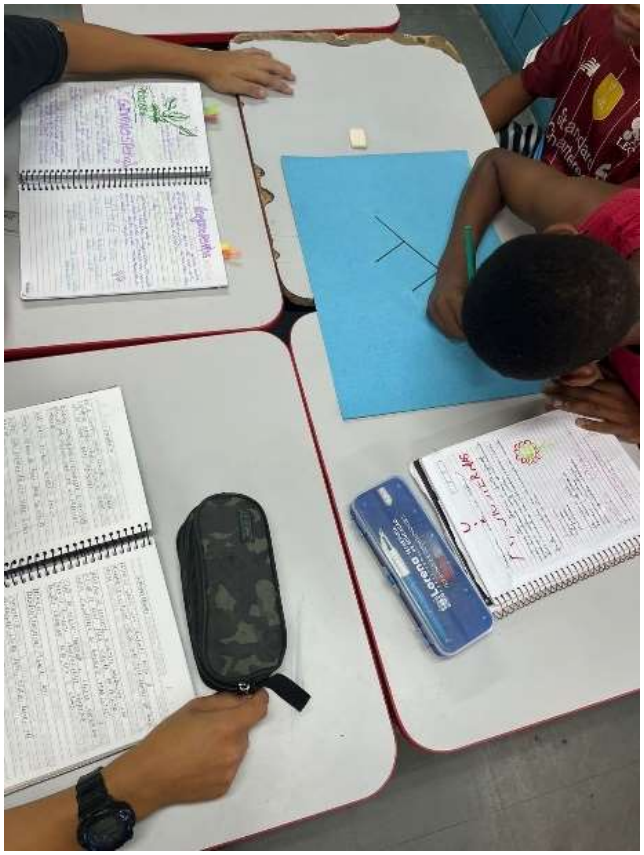

Figure 2 – Production of cladograms by groups of students. Source: authors (2023).

Thus, the groups demonstrated the production of their cladograms to the entire class and justified the evolutionary order and proposed characters. The presentation was attended, and all information explained by the groups was noted. All groups correctly placed the evolutionary order of plants: Bryophytes, Pteridophytes, Gymnosperms, and Angiosperms. Regarding the characters, group three made a mistake in stating that leaves and roots appear in Gymnosperms, when in fact these structures are characteristic of Pteridophytes, and group six made a mistake in attributing the presence of conducting vessels to Bryophytes. They were corrected by the class and the teacher, who subsequently adjusted the cladogram.

The construction of cladograms in groups is a way of enabling students to engage in debates and make decisions in a collaborative learning environment that, in addition to helping to build new knowledge, also improves communication and problem-solving skills (Lima and Antunes 2022). All groups submitted their cladograms, which was a positive aspect as it enabled discussion for knowledge building.

Roundtable discussion on the production of cladograms

At this stage, the cladogram produced by the group was discussed in a roundtable conversation. Each group presented the material in class and the class discussed the correct position of each plant family within the cladogram. After the groups had constructed and justified the characters and evolutionary order of the cladograms, a roundtable conversation was held to discuss the results obtained. It was found that the students were able to correctly position the groups in the cladogram, which was considered a positive aspect. This result is in line with the guidelines of the National Common Core Curriculum (BNCC), which highlights the importance of an evolutionary approach in science education, considering that these concepts are fundamental to understanding life. In other words, understanding the evolution of species is an essential part

of a student's basic education, providing the necessary knowledge about the various forms of life present on our planet. Therefore, the study of phylogenetics becomes indispensable in the teaching of botany (Ramaldes et al. 2023).

Identification of plants in the school environment

At school, there are specimens of bryophytes, pteridophytes, and angiosperms. These plants were numbered (Figure 3), and the students, divided into groups of five, had to classify them according to: group name, group characteristics, and ecological importance, filling in a table with this information.

Figure 3 – Plants listed for identification by students in the school environment. Source: authors (2023).

All groups were able to find and correctly identify the plants displayed in the school environment that had been previously listed. The identification of plant groups in the school environment was evaluated as satisfactory because it brought students closer to the plant groups studied, facilitating the visualization and observation of the main characteristics of the groups.

Practical classes are extremely important for students to understand the content in the area of biology and especially botany. Providing practical activities in familiar environments to students enables the consolidation of knowledge, bringing the content closer to the students' reality and assisting in learning (Sousa et al. 2021).

Discussion circle on the production of identification tables

After the students worked in groups to classify the plant groups in the school environment, highlighting their characteristics and ecological importance, there was a roundtable discussion to correct the tables produced. At this stage, the students received back the table produced with the corrections made so that the groups could explain which plants were observed. Thus, the teacher first asked questions about each number found: "What is plant number *?", "What characteristics did you observe in this plant?" and "What is the ecological importance of this group of plants?" During the roundtable discussion, all students actively participated by answering the questions and discussing the group of plants they had observed. This stage was evaluated as positive not only because of the performance of the students who answered all the questions correctly, but also because of their participation in the roundtable discussion.

Thus, group discussion is advocated as a possible tool for data production, as it seeks to investigate a social environment. It is therefore seen as a space for training and exchanging experiences that can be used in

research in the field of education. Each participant's statements are constructed based on interaction with others, leading to understanding, reflection, and better perception of the object of study (Moura and Lima 2015).

Drawings classifying plants outside the school environment

The students were challenged to observe plants outside the school environment and submit four drawings, representing each group, accompanied by justifications that demonstrated the characteristics and classification of the plant. This activity was carried out individually.

Of the 30 participating students, 29 submitted their drawings in class, totaling 116 drawings. Upon submission, the drawings were examined to see if they possessed the characteristics of the plant group in question (Figure 4).

Figure 4 – Drawings made by the student and handed in during class. Source: Author's production (2023).

Most students were successful in the task of drawing and illustrating the plants, with 27 students producing a total of 114 correct drawings. However, the errors identified were used as an opportunity to deepen classroom discussions. It is essential that teachers use students' mistakes as a tool for knowledge building. By employing mistakes as pedagogical tools, teachers can inform and promote debates that help students overcome their difficulties (Aquino 2023).

Presentation of the material produced by the students

The students individually presented the drawings of the four groups of plants orally, justifying the plant group identified in relation to the proposed drawing. It was explained to the students that this stage of presenting the drawing and classification with justification would be evaluated using three criteria:

presentation posture, knowledge of the topic, and correct justification. During the presentation, it was observed that all students presented their work with confidence. Regarding knowledge of the topic, 22 students presented their work confidently. As for the correct justification relating the drawing to the plant group, 27 students were able to make this correlation adequately. Two students made mistakes when justifying the bryophyte and gymnosperm groups.

The activity was evaluated as satisfactory, as all students, dealing with embarrassment and insecurity, presented their drawings and justified them orally to the class. In addition, the vast majority of students demonstrated confidence and knowledge of the content, presenting neat drawings with the correct classification.

Working on oral skills in the classroom is essential, as speech is an important component in the student's life. Through oral expression, students expand their communication horizons, improve their thinking, socialize, organize information, interpret the world, present ideas, debate points of view, express emotions, improve their argumentation and communication, and prepare for a professional future in which they will be able to express their knowledge and ideas in public. Thus, the development of oral skills is of great importance for social interaction, in addition to helping students become articulate, participatory, and critical members of society (Chaer and Guimarães 2012).

Production of an e-book

After producing all the material in drawing format, the students were presented with the proposal to create an e-book for identifying the main groups of plants, in a conversation circle. To start the debate, questions were asked, such as: "What do you think about producing an e-book with this material identifying the main plant groups?", "How do you think the e-book should be?" and "What do you think should be in this e-book?". The students shared their ideas, and the e-book was created using the Canva program® in partnership with the students. The students' participation in the discussion about the production of the e-book was satisfactory, as they were enthusiastic about producing this material and participated by making suggestions.

Field trip

A visit was made to the Taboão Ecological Park located in the municipality of Lorena, São Paulo, which covers more than 80 hectares of environmental protection and preservation area and is supervised by a biologist responsible for the services. The existence of an ecological park is extremely important for promoting environmental education and raising awareness among students, proposing practices that aim to improve society's relationship with the environment (Silva, 2023).

During this visit, the biologist welcomed the students and gave a lecture on "The importance of plants." During the visit, the students learned about plant groups and their ecological importance. The biologist conducted a rain simulation in a degraded area and in a forest area so that students could see in practice the importance of plants for soil and water (Figure 5).

Figure 5 – Test simulating the effect of rain on degraded and non-degraded soil to observe water infiltration. Source: Author's production (2023).

Viewing the plants during this stage of the sequence is essential and makes students more interested and motivated, helping them achieve satisfactory results and encouraging direct contact with nature (Santos, 2015). All students reported being satisfied or very satisfied with the visit and the knowledge they acquired during their visit to the ecological park. After responding to the report, the students toured the park in groups using the e-book to view the plants present in the park and take photographs for the future production of a mural.

Dissemination of knowledge: production of the mural

It was proposed that the students produce a poster displaying photos, drawings, and texts of the knowledge obtained during the visit to Taboão Park and throughout the entire teaching sequence for dissemination to the school community. The students, in groups of five, made the poster, which was displayed in a previously defined area of the school (Figure 6).

Figure 6 – Mural produced by students after visiting Taboão Ecological Park located in the municipality of Lorena. Source: Author's production (2023).

The use of murals is a useful resource for students to visualize and disseminate the knowledge they have acquired. In addition to invigorating the school environment, the walls become pedagogical tools that have great potential to promote student learning (Pinto 2021).

Culmination

At the end, a culmination was held in the form of a roundtable discussion to review the contributions and possible improvements to the project. Students were encouraged to answer the questions: "How did this project contribute to you?", "What do you think could be improved in the project?" and "List the positive and negative points of the project." It is important to obtain the opinion of people participating in the activities to verify their efficiency and seek continuous improvement of the work (Almeida et al. 2023).

Students were asked if there were areas for improvement in the sequence. Students responded that there was a lack of attention on the part of some students, some distractions related to games played by the students themselves, which may have affected their performance. They were asked if any students lacked interest in the project, and all responded that they did not.

Final Considerations

This research sought to evaluate a teaching sequence as a strategy for teaching botany to 7th-grade elementary school students. The sequence strategy was designed to encourage full student participation and engagement in the learning process. Each stage was meticulously structured to promote an interactive and dynamic approach. Initially, there was a strategic discussion circle to raise students' awareness of the project, seeking to encourage dialogue and interaction among students. This approach created an environment conducive to sharing prior knowledge on the topic, promoting a collaborative atmosphere. In the end, emphasis was placed on valuing the students' opinions in a culminating activity. The opportunity to express

points for improvement in the project was deliberately included, providing a space for joint reflection and continuous improvement.

The results showed that the teaching sequence enabled students to efficiently understand plant groups, promoting understanding of the morphology and nomenclature of each group and helping students learn about the role of plants on our planet.

It was clear that the students' experience with plant groups—bryophytes, pteridophytes, and angiosperms—in the school environment facilitated meaningful learning. The only group absent from the school surroundings, gymnosperms, and therefore the only group not seen by the students, was the one that obtained the lowest percentage of correct answers in the final assessment. This fact possibly indicates that students' contact with plants is important in the learning process.

Based on this analysis, it is suggested that teaching sequences be designed to promote greater student interaction with plants. Examples include building gardens, vegetable gardens, practical activities at school and in the school surroundings, field trips, and landscaping in the school environment.

The e-book developed during the teaching sequence, integrating the students' ideas and drawings, was a form of participatory construction of educational material that students could use during the field trip.

The students' maturity in this process was evident, as they recognized that some negative aspects of the project were due to their attitudes and commitment at certain moments during the research.

It is extremely important to provide students with opportunities to evaluate the sequence and assess themselves. Self-assessment allows students to reflect on their own responsibility in the teaching process. It is important for students to be aware that they play a fundamental role in the construction of their own knowledge.

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