THE STUDY OF PLANT BIODIVERSITY THROUGH INQUIRY BASED LEARNING: DIDACTIC PROPOSAL

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INTRODUCTION

The learning and teaching of science based on research is an effective and motivating pedagogical approach that places students at the center of the learning process and establishes the student's analogy as a scientist.

This study presents a didactic proposal for the teaching-learning of the concept of biodiversity through inquiry based learning (IBL). This model is based on the usual ways in which scientific activity is carried out and proposes that the student work in the same way that a scientist would do by simulating said activity but adapting it to the specific objectives of education school scientist.

To do this, an interconnection between three educational figures will be established: researchers, secondary school students and teachers.

We believe that this proposal not only motivates and generates interest in learning science in students, but also allows the development of active and cooperative learning.
In particular, this guided research project, which focuses on plant biodiversity, aims to increase the level of knowledge of the participants about the great diversity of native plant species of the Iberian Peninsula, familiarize high school students with the scientific method and classification systems plant and positively influence their attitudes, habits and behaviors in relation to habitat conservation. In parallel, it is intended that students, either free or guided, develop a critical and responsible attitude and design their own teaching material in order to transfer the new knowledge acquired to their centermates.
The following are specific objectives:

(i) recognize the most emblematic plant species of our natural environment by identifying basic morphological characters.

(ii) identify the defense mechanisms or physical, chemical and biological adaptations of plants to the Mediterranean climate.

(iii) bring students closer to the way of proceeding of the scientists.

(iv) design didactic materials (collections, herbarium sheets, photo gallery, scientific poster, etc.).
The guided research work was developed in three different sessions according to the didactic sequence:

Session 1-Field work: First, the collaborating researchers organized a reception to the working team (formed by the participating students and their teaching staff) and presented the research project whose main theme was plant biodiversity and the type of adaptations of plants to the climate of the study area. The working team was received by researchers from the University of Jaen and, after the presentation of the project, made a joint visit to the green spaces and the Native Flora Garden of the university.
During the visit, the students tried to identify the plant species that most caught their attention through the use of identification guides, as the guide of the Ornamental Flora of the University of Jaen, and the free application ARBOLAPP, jointly prepared by the Royal Botanical Garden and the Scientific Culture Area of the CSIC for the identification of wild trees in the Iberian Peninsula and the Balearic Islands.

In parallel, the plant material was collected (small branches/leaves and/or fruits, minimum essential and without damaging the specimens) for subsequent pressing and labeling. The students visit the university herbarium to press the plant material and see the storage system of the sheets of the collection.
Session 2-Laboratory work: The working team returned to the University of Jaen to visit the teaching and research laboratories and they were taught firsthand the way of proceeding of the scientists, who must simulate them in this second work session. Once in the laboratory, students had to try to identify different types of physical adaptations (sclerophilic leaves, that is, hard and resistant to dehydration, presence of stingers or spiny margin, pubescence or presence of tomentum - white skins, etc), chemical (aromatic leaves, presence of essential oils, etc.) or biological (secretion of substances to feed small predatory insects that keep the plant free of pests). For this, they had laboratory equipment and instrumentation such as tweezers, lancets and binocular loupes, as well as identification guides and work sheets.
The group, which was guided by the researchers during the session, had the common objective of correctly identifying and labeling the plant material collected in the previous session as well as describing the adaptations by them observed. This information was collected in their work sheets. In addition, they prepared sheets or collections of plant material to be taken to their educational centers and be used by students/teachers for teaching purposes. For this purpose, they had at their disposal the necessary material.
**Session 3-Seminar:** The work team met in the third and final session whose purpose was to synthesize the information obtained in the previous sessions and receive some basic guidelines for the realization of a scientific poster.

Since the students are considered as scientists, it is important that they know how to proceed in the presentation and dissemination of the results and conclusions obtained in an investigation to the rest of the scientific community and society in general. The students designed its own scientific poster, being able to synthesize the most significant information by critically selecting it and preparing a brief presentation of its results and conclusions.
RESULTS

As stated in the previous section, high school students and teachers who were part of the work team performed all the tasks entrusted with great success, working cooperatively and solving the problems and small challenges that arose throughout the teaching-learning process of science through guided research. After completing the didactic sequence, students were able to distinguish the scientific processes involved in a research work, identify different native plant species according to different criteria and be aware of the existing biological wealth in our environment.

The results show, as a summary, the collection of herbarium sheets that were made with the plant material collected from all the species studied and the scientific poster that was exposed by the group.
Two types of evaluation were proposed after completing the research work: a co-evaluation, a joint assessment carried out by students on their actions according to established criteria, and a self-evaluation, a process where students evaluate their learning experiences throughout of process.
Learning and teaching science based on IBL has proven to be effective and a motivating experience. The students have been able to understand and internalize the concept of biodiversity through experimentation, working as a team as scientists. They have developed their own science skills, they have achieved the objectives set in a rigorous way and they have been able to present their results and conclusions in front of a small audience. This experience has been valued as very positive by the participants.

The didactic proposal shown here can be easily replicated in middle and high school. Among the advantages of using this methodology are the stimulation of the intrinsic motivation of students to learn science, the autonomous and cumulative development of learning and the promotion of cooperative work. This type of proposal obviously has its limitations, among which we highlight the difficulty of creating opportunities for students to come into direct contact with the researchers and work together with them in a single work team.
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