THE STRUCTURE OF THE FLOWER AND THE INFLORESCENCES PHENOMENON IN PRIMARY SCHOOL

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Abstract

With a view to active learning, that makes the students protagonist, responsible and aware of the learning process, the present study presents an experimental work designed to demonstrate the usefulness and validity of the scientific method as the basic element of teaching Life Sciences. The experimental research was implemented in two second-grade classes at a Primary School in San Donà di Piave (Italy). Its purpose was to test the potency of a teaching approach based on the scientific method, particularly the observational-comparative method, in the teaching of Life Sciences, focused on the structure of the flower and the inflorescences. For this reason, it was decided that one of the two classes used the experimental method instead of a traditional teaching-learning method based on the oral transmission of contents. During the action, students were invited to use scientific tools in each lesson as magnifiers, stereoscopes, and specimens of flowers. Active teaching and direct observation of flower structures reinforced the concepts theoretically exposed. This way, the high teaching potential of integrating macroscopic and microscopic observations was also confirmed. The observational-comparative method is a key component of the study of Biology. For this reason, all the topics linked to the study of plants can be addressed through the use of this active methodology. This kind of approach can motivate students, making them active participants in their learning. The obtained results showed that using the scientific method and laboratory tools such as the optical microscope or the magnifiers, conceptualizations planned for fifth grade, can be met with success also in second grade, helping to reach the programmed goals optimally and often excellently, facilitating the achievement of competences such as the use of a correct scientific nomenclature. With this approach, the young students were motivated, stimulated, intrigued, and this potentially provides meaningful, authentic and transferable Lifelong Learning and the development of a scientific culture together with an early interest in the Sciences.

Keywords: life sciences, primary school, flower structure, inflorescences, experimental method.

1 INTRODUCTION

The importance of teaching Life Sciences in primary school is to broaden the traditional vision and the concept of scientific education in schools nowadays. In fact, in the first cycle of education, most of the time Biology falls within the competence of general Sciences and consequently it is unthinkable to deepen all its topics, whereas the few hours granted to the teaching of this school subject. However, it is possible to provide students with a comprehensive view of this discipline (Palmieri et al., 2019; Masiero et al., 2022). In

pursuing this aim, it should keep in mind some significant stages of Sciences in general such as the concept of “laboratory” in the classroom as not only a specific place where the products are manufactured, but understood as an environment in which students acquire cognitive styles, understanding their value depending on their specific purposes, and through which to observe the world around us (Arcà, 2009; Meneghetti et al., 2017; Massaro et al., 2022). A laboratory is a space where children can get directly in touch with concrete reality, acting in person and where students are motivated to develop their Critical Thinking (Arcà, 2009; Tonon et al., 2013; Forlin et al., 2018). This is achieved by highlighting strategies, categories and structures of Thought that guide the comprehension of phenomena using the scientific method of research, congenial for primary school pupils who need the manipulation of the contents.

Another important element is the foreknowledge of the students. Teachers have to give it the right value, considering it as a starting point in science education since it makes it easier to learn new knowledge (Andean, 2007; Pavan & Santovito; 2014; Tura et al., 2018; Zandonella Necca et al., 2021). Moreover, by examining and discovering the events of nature in person, children build a network of knowledge, composed of experiences reproducible in a controlled environment, through which they can reprocess the concepts learned and expand their network of knowledge.

All these theories converge in the idea of an active teaching programme for Science and Biology. To achieve this objective there are different training, but all start from the lectures completed with experimental activities, demonstrations, experiments and investigations. The participation of students should be more active. They must observe and experience in person to learn more deeply and consciously (Longo, 1998; Toninato & Santovito, 2015; Tonon et al., 2020). Therefore, active laboratory didactics is the most desirable way to teach Science in primary schools.

At last, it is essential to resort to a “phenomenological approach” with students who learn biology. This involves the use of a "fact of reality”, that is an event used in the classroom to begin to reflect students on the phenomena that surround them” (Alfieri et al., 1995). This allows a gradual approach to the knowledge scientific discovery through spontaneous and deep involvement. This last concept inevitably implies “knowing the world”. The knowledge of the world, above all during the first years of school, has to begin from exploring the “small world” that surrounds children in their daily life (Grando et al., 2018a, 2018b; Lui et al., 2019; Fabris et al., 2020; Furlanetto et al., 2021). But also an ecological perspective, correlating the personal microcosm with the macrocosm of the planet: it is at this age that the child acquires the “ecologist thought”, intended as respect for Nature as a logical condition to better live (Capparotto, 2017; Fassinato et al., 2018; Gallina et al., 2019; Bortolami et al., 2020).

1.1 The purpose of the Research

The purpose of the research was to test the effectiveness and validity of an educational project achieved through the experimental method, supported by observational and comparative methods. This innovative teaching has been compared to traditional teaching, which has its bases in the oral transmission of subject content. The experimental method is a kind of investigation in Sciences. It consists of the collection of measurable data through observation and experimentation related to a specific phenomenon. With this information, it is possible to formulate a different hypothesis. Through this type of survey, the hypothesis can be confirmed or rejected, but it is essential that the data preliminarily collected can be used to make new experiments until the results obtained are always the same.

In particular, in this research have been used the experimental method for the activities on flowers and the studies of their inner structure. The observational-comparative method was used for the studies on inflorescences.

The observational-comparative method, however, has been used for the macro and microscopic observation of different kinds of flowers, especially for the shape and the colours of the petals. Carefully observing and comparing both with the naked eye or with the microscope, the morphology and characteristics of flower species, have come to grasp the regular and common structure of the flower and at the same time some differences that set them up in various families.

2 EXPERIMENTAL PHASE

2.1 Field of Intervention

The activities have been carried out in two secondary classes of “Forte ’48” Primary School located in San Donà di Piave (Venice - Italy). It was decided to use one of them as the experimental class and the other one as the control group for observation in which the teacher continue to teach students in the traditional oral

way. This choice is derived from the volition to observe a comparison between the two methods of teaching and thus appreciate the value and effectiveness of the experimental method in Science teaching. The 2A where was acted the experimental project was composed of 19 pupils while the 2B by 18.

2.2 Experimental Plan

In the second grade A, the experimental class, the research project lasted 20 hours and consisted of two phases: the first relating to the flower and its structure, the second for learning inflorescences. At the end of both steps, it was administered a test, and the results were compared with the results of the same test administered in 2B, the control class, where the teacher used the traditional method to convey to students the content of the flower.

The inflorescences were taught only in 2A because the teacher did not consider it appropriate to introduce them into the curriculum of the class, and also because of the difficulty and complexity of the topic.

All the lectures were reinforced by a theoretical introduction since it was better to give students some theoretical bases that fixed the practical and experimental observations. So it has been utilized the traditional method in the 2A is to introduce and well-defined the topics.

The whole experimental project was actualized according to the following division:

First phase
Introduce to students a real sample of flowers and, afterwards, of inflorescences to observe, defining particularities.
Second phase
Call up previous observations by isolating structures and defining the name and function for everyone. Back to specimens isolating the components just learned.
Third phase
Observe with magnifiers and with a microscope all the components of different species of flowers and various inflorescences, discovering a recursion and equality into the structures of all the flowers and the kind of structures of inflorescences examined.
Fourth phase
Develop a mature and conscious learning of the contents observed and known by playing.
Fifth phase
Test and assessment of the new learning.

Instead, in the control group the project has been achieved in only two hours (only the flower) by using the frontal method of the oral transmission of the contents.

3 METHODOLOGIES

During the experimental trial, it has been used different teaching methods. Each topic was addressed by following a well-defined sequence, recalling the experimental method:

- Observations with naked eyes;
- Observations with scientific tools;
- Hypothesis about the observations;
- Comparisons between different species;

- Confirmation or refutation of the hypothesis.

It has been also used as an oral transmission of the subjects for the descriptions and the particularities. This aspect has been useful to reinforce the abstract ideas and the complex contents observed with scientific tools and discussed through brainstorming in small groups or with the whole class group. Some innovative elements in the experimental teaching were the use of new technologies that have been essential in the research project, which made it possible through the use of IWB (Interactive whiteboard); the use of a laptop to show children some pictures of details and offer a nanoscopic view of flowers structures; some cards to support students during the learning process, in which pupils can highlight an important aspect of the teaching, nouns, definitions; some cards on inflorescences designed as those of the Memory game to make the learning more fun and entertaining since playing being an activity as natural as possible for children, it appears to be a very effective means of learning. For this reason, it was decided to create two game moments (one for the flower and one for the inflorescences) to strengthen the pupils' knowledge; a daily use of real specimens of flowers and inflorescences; finally a trip into the school garden for direct observation in the field.

4 RESULTS

4.1 The results of the Experimental Activities

4.1.1 The Results of the First Step: Flower's Structures

The course was held on flowers, at first, with a trip into the garden of the school to observe flowers in their real habitat and to collect some of them to use as samples. This first lecture was structured by alternating the detection of background knowledge, with a clinical conversation, and the explanation of the new concepts. Every lecture started with a "card of the scientist" in which every pupil had to fill in some area or answered some questions with their prior knowledge. First of all, pupils were invited to express the concepts already known of flowers as the petals, the stem and pollen. Then I start to break down a flower into all its parts showing the students the different structures with the naked eye and then through the use of magnifying glasses. In this way, there were introduced the names of all the components of a flower were.

The ovary and the pollen, it was created in a laboratory using a microscope and through it, children were able to know other physical aspects of them (Fig. 3 and 4). At the end of the lessons, students had to fill the final part of their daily "card of the scientist" with the new knowledge learned during the lesson and compare them with the old knowledge. The recognition of the background knowledge was very important because it represents the starting point for the construction of the pupils' new knowledge.

Figure 3 The ovary of a poppy shown to pupils with a microscope during laboratory didactics.

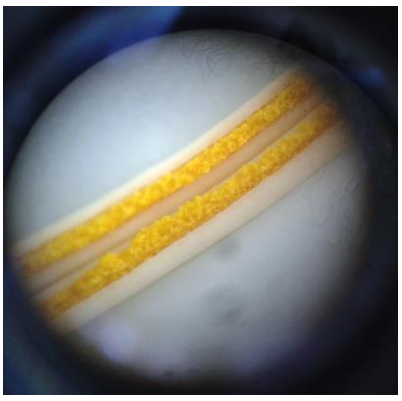

Figure 4 The pollen of a lily shown to pupils with a microscope during laboratory didactics.

Based on what emerged every day from the discussion with children an explanation was built on flower structure, touching the following points: definition of every part of it; definition of functions of every part; the importance of flowers in our life; the pollination process; recognize that every species of flower has the same structures; the fruit (again names of all the part of it, and their functions).

Based on their prior knowledge, pupils have been able to change some knowledge naive and it was possible to lay the groundwork for the following tasks in the laboratory.

Then analysing the grape, I ask the students: "If from one flower grows only one fruit, from what came from a grape?". Students were provided with all the knowledge to say: "From a lot of little flowers all near in one

whole stem!". The concept of inflorescences, in this way, was already known to students as a foreknowledge.

4.1.2 The Results of the Second Step: the Inflorescences

In the same way as the flower, students were gradually introduced to the concept of inflorescences by the first observation of different samples. inflorescences are divided into four macro categories and for everyone, there are a lot of different species. Since it is a complex argument for a second grade, I decided to teach only seven kinds of inflorescences (Umbel, Racemose corymb, Spadix, Head, Catkin, Racemose, Spike), and for doing it I created some cards for a "memory game": each species had three cards, one with the explicit name, one with an image of a specimen, and the last one with a reference that could be an object, an animal or figure, that recalls the species and acted as a hook between the kind of inflorescence and an object present in the everyday life of students (Fig. 5).

Figure 5 Flashcards created to play the "memory game" with the seven types of inflorescences; in the photo, the three cards are designed for the Umbel inflorescence.

After the game, this theme has been addressed with active and laboratory didactics: all seven inflorescences were shown to children using a laptop and some nanoscopic imagines (Fig. 6) and in a second moment, as was acted for the flower, dividing students into seven groups, it was given a species to be decomposed into its parts (Fig. 7) and especially were emphasized the structure and the position of individual flowers on the main stem. Students used again scientific instruments, and through the microscope, it was possible to show the students the inflorescences more hidden, like the daisy sample (Fig. 8).

Figure 6 Images shown to pupils to observe more hidden and peculiar inflorescences.

Figure 7 Example of laboratory activity during which pupils have used scientific tools to observe real flowers

Figure 8 The Head inflorescence of a deasy shown using a microscope; pupils could distinguish the individual flowers that composed it.

When the two single didactics steps ended, was administered a test. The same test (the one on the flower) was administered to the control class, and in parallel to the workshop, activities have learned the concept of the flower with an educational trail of mere oral transmission of content. The results obtained from the tests on the flower in the two classes were qualitatively better in the experimental class, which showed to know acquaintances more deeply and maturely of the concepts, and also the functionality of all the structures presented. This confirms that this research presents an educational innovation project for two reasons: the methodologies implemented, which are more effective, and also for the topic of the inflorescences rarely treated by Science teachers.

5 DISCUSSION AND CONCLUSION

The goal of this research involved the teaching processes of flower structures and the new topic of inflorescences through innovative laboratory didactics using real samples of flowers and scientific tools, the experimental method and the observative-comparative method. The first particularity of this project is the fact that it was addressed to two-second classes of Primary School when usually this argument it's not proposed in this grade. Another characteristic is that this study was designed and made in the way described to give value to the feasibility of this topic with so young students, who have shown, in fact, a great interest in it and achieved excellent results in the activities proposed to them.

Another important target of this experimentation was to prove the efficacy of laboratory didactics in the teaching of Life Sciences, placing it in comparison with traditional teaching methods. For this reason, the flower's unit was proposed in the other second class with the oral transmission method of teaching and based on the results obtained by the tests given, compared the validity of the two types of didactics.

In traditional teaching, knowledge is transmitted passively from teacher to student. Pupils learn through a deductive method imposed by the teacher, who provides solutions and answers to problems. There is a constant reference to the textbook, on which the teacher based all the activities. In the traditional method, Teaching is central and children's learning is overshadowed (Gaiotto et al., 2013; Trevisan & Santovito; 2015; Rossi & Santovito, 2016; Barbacovi et al., 2018).

Vice versa the laboratory didactics prefers an inductive method. By it, students can find out for themselves the regularities, the rules and the constants of the considered problems and learn by discovery, building knowledge networks in social interaction with peers, anchoring all the phenomena observed and studied to their experiences and their everyday lives. The student is now the protagonist of the learning process, while the teacher acts as an indirect expert guide (Zanata & Santovito, 2020; Furlan et al., 2021; Cazzador et al., 2022; De Rossi et al., 2022).

In this project, students who were able to approach the experimental method, have had the opportunity to work within a scientific community of learning, discovering the theoretical concepts, observing them, manipulating them, and resorting to specific instruments, thus promoting deeper and more mature learning than the one offered by the oral transmission of concepts learned through the study of mnemonic names and definitions on textbooks. The concepts concerning biology might be difficult for the youngest pupils, therefore it might be useful to approach them indirectly through stories. These stories can present characters and

backgrounds related to biology, in a fantastic way that ignites the light of imagination and at the same time transmits knowledge (Barana et al., 2021; Pavan et al., 2021; Bolzon et al., 2022; Gaiotto et al., 2022).

For studying flowers and also inflorescences, the steps of the experimental method of investigation were followed and some scientific tools like microscope and magnifiers were used in the activities, which reinforced the hypothesis that learning is more meaningful with laboratory didactics in which pupils learn more through direct observation and the manipulation of contents in the field of knowledge. Activities have been also implemented by observation and comparison between various types of flowers and again for the inflorescences, and it has been tried to generalize the essential characteristics for all the plants.

Moments of experimentation have been integrated with moments of reflection and discussion on what was being built by sharing knowledge with classmates. Indeed, “the interaction and discussion” as instruments of teaching “to transform an object of experience into an object of discourse, they need a speech that must be negotiated and shared and which should be approximated to the scientific one, when students become more aware” (Lago et al., 2017; Chiesa et al., 2019; Bertoncello et al., 2021; Frigerio et al., 2021).

We have also tried to raise pupil's curiosity and motivation by creating a connection between their everyday life and proposals of the experimental laboratory, experiences that were able to create a solid foundation on which to build lifelong conscious learning (Favaron et al., 2017; Corbolino et al., 2020; Gaiotto et al., 2020; Lago et al., 2022).

Another important element of this project is the use of specific terms. If they are discovered by the students themselves and not learned with abstract oral teaching, based on the exercises commonly offered by the textbook, they can be useful to compose a glossary and a precise vocabulary that students will be able to remember.

Finally, we used drawing as another way of expression to guarantee the best of what pupils have observed with care during the lectures. Moreover, bearing in mind the age of the students, even playful learning was an important aspect during the realization of lessons, such as the memory of inflorescences.

In conclusion, the laboratory didactics, the experimental method, the observational-comparative method, the real sample of flowers and inflorescences and the scientific instruments used in this research have proved their importance for the transmissibility of experiences in different contexts and meaningful learning in Life Sciences (Zandonella-Necca et al., 2014; Gaiotto & Santovito, 2016; Bassi et al., 2021; Serato et al., 2022). All the activities described and proposed in this project can be addressed to students of other ages with appropriate adjustments, and the results shown in this work demonstrate that the flower's structures can be proposed in all the primary grades and that the inflorescences topic is an understandable argument also for so young students.

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