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**METHODOLOGICAL ASPECTS OF APPLYING STUDENT-
CENTERED STRATEGIES TO BIOLOGY**

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Abstract

The active participation of students in learning is done in biology lessons by selecting and applying the didactic strategies appropriately. By using student-centered strategies, such as active learning or collaborative learning, the role of the professor of knowledge transmitter changes, becoming a mentor, guide, or collaborator that facilitates the knowledge of the various aspects studied by the students in Biology. The aim of this paper is to highlight the possibility of applying the two strategies mentioned above in biology lessons, in gymnasium. In order to achieve the proposed goal, we analyzed the content of the current Biology programs and manuals developed for the 5th grade, investigating the possibility of applying certain active and collaborative learning strategies. Analyzing the content of the ten school textbooks approved by the Ministry of National Education, we selected two of them, in order to implement the aforementioned strategies in the classroom didactic activities. Thus, at the "Gymnosperms" lesson, we propose the use of an active learning strategy. For the lesson "Pisces", we propose the use of a collaborative learning strategy. The "Cube" and "Starburst" methods applied to groups of students will be used. The review lesson about vertebrate animals can be conducted according to a collaborative learning strategy, applying the interactive Search - Think - Build strategy. By applying student-centered strategies, such those of active and collaborative learning, lessons become more attractive to students, ensuring progress in understanding and acquiring knowledge in biology.

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1. Introduction

Student learning in education process involves a change in behavior due to an experience or learning exercise. By engaging students in different learning situations, a change in behavior can occur, be it new behavior, the disappearance of a behavior, or the emergence of a complex behavior.

Learning "is a personal act that engages the student in the totality of his being; is holistic through the influences exerted on personality development in all its aspects" (Cerghit, 2006, p. 68).

By analyzing the concept of learning from the perspective of both the actors of didactic activity, it can be considered that for the pupil learning is "the specific human way of acquiring knowledge, skills or attitudes (Grande dictionnaire de la psychologie, 1994, p. 58)", and for the teacher is "an activity designed, organized and conducted by the teacher in order to determine behavioral changes in the personality of the student" (Dulamă, 2001, p.10).

In order to stimulate pupils' learning activity in biology lessons, the teacher can choose a certain way of combining methods, procedures, means of education and forms of organizing the activity, aiming to transform the student from a passive participant into a seeker, experimenter or rediscoverer of the content of biological concepts, processes and phenomena.

Regarding the student-centered approach, Cojocariu considers that this is "a way of approaching the instructional-educational process that has as a goal the optimal valorisation of the pupil as a subject of learning" (Cojocariu, 2009, p.96). The author mentions five categories of student-centered teaching strategies, which "have as central point the facilitation of learning" (Cojocariu, 2009, pp. 96-101).

Thus, the mediated learning strategies have as their starting point the theory of Vigotsky's intelligence development and Feuerstein's mediated learning practice. Considering that the student has a development area accessible only by an adult, the teacher is the one who will facilitate the cognitive development of the student. It will help the student learn how to learn. As the author states, mediated learning is the strategy most suited to the pupil's cognitive abilities, assuming the very accurate psychological knowledge of each student.

Active learning strategies are teaching strategies that enable the student to actively interact with the material to be studied, to have direct contact with the student. By applying active-participation methods, such as heuristic methods and practice-based methods, the student is encouraged to actively participate in the learning process (Cerghit, 2006, pp. 68-73).

Case simulation-based learning strategies are based on real-world data and situations. Simulation can be done individually, by group or with the whole class, following the formulation of punctual problem solving. Applying this strategy requires prior training of the teacher, who has to find and present real cases or to design certain cases that simulate real situations. Among the methods that can be used to implement this strategy, we mention role play and case analysis.

Collaborative learning or collaborative learning strategies are based on teamwork. Student group members are trained to work together to solve some work tasks. This stimulates an interactive or interdependent group learning. The interactive methods that can be applied in these strategies assume the students' willingness to cooperate and collaborate, to share their ideas, opinions, views and experiences (Bocoș, 2002, p. 86). Cooperation, working with someone, "is a form of learning, study, mutual interpersonal / intergroup action" and focuses on the process of achieving the task. Collaboration is "a form

of student relationship [...], which consists in solving issues of common interest, in which each contributes actively and effectively" (Oprea, 2009, p. 147).

The latest strategies mentioned by Cojocariu are those of the type of learning experience. They are based on "the idea that the maximum profit in learning is obtained by experimenting with novel situations and transferring knowledge thus acquired to new learning situations" (Cojocariu, 2009, p.100). Focused on student experiences, the role of the teacher is to facilitate positive learning experiences.

2. Problem Statement

"Already in the first half of the 20th century, the authors of the most relevant works of a methodical nature referring to the teaching of natural sciences in the Romanian secondary education, paid special attention to the pupils' learning activity within a lesson" (Petruța, 2017, p. 268).

So, "some of the methods mentioned by Moisilu, Kirițescu and Simionescu (cited by Petruța, 2005), such as independent observation or observation guided by the teacher, heuristic conversation and modeling made using molds or drawing, are also used by today's teachers in biology lessons, being considered active-participatory methods" (Petruța, 2017, p. 268). Given that the active participation of pupils in acquiring new knowledge is ensured by applying the heuristic methods mentioned above, today it can be appreciated that since that time some teachers have applied active learning strategies in biology lessons. Nowadays, in order to improve student's understanding and acquiring of the concepts of biology, teachers can use in their lessons both active learning strategies and collaborative learning strategies, having the opportunity to use the most appropriate methods from the diverse range of existing teaching methods.

Taking into account that "didactic models can be applied on the basis of training strategies (didactic strategies)" (Ciobanu, 2009, p. 395), it can be considered that if an active learning strategy is applied in the lesson, then the teacher will choose for the psychosocial training model. If the teacher uses a cooperative learning strategy in the lesson, then the sociocentric training model will be applied. Sometimes, at the time of the lesson project, the teacher may consider that combining the activity carried out individually with the one carried out within the group of students is effective for learning certain scientific contents. In this case, he will have the option to choose for the psycho-sociocentric training model.

When the content of the biology lesson is difficult to understand by students and requires the teacher to explain and / or demonstrate certain concepts or phenomena, the logocentric model may be applied in combination with one of the training models mentioned above.

Choosing the teaching strategy to be used in a biology lesson is a personal decision of the teacher. It depends on his/her skills and qualities as well as on many other factors, including: the scientific content of the lesson to be taught, the competencies mentioned in the curriculum, the available teaching resources, the age and individual peculiarities of the students, the characteristics of the class of students, and others.

3. Research Questions

The study was guided by the following research questions:

- 3.1. Are there differences in how to approach scientific content on a topic in the ten biology textbooks approved by the Ministry of National Education for the 5th grade?

- 3.2. Is it possible to apply active and interactive learning strategies for the lesson topics that are considered in this research?
- 3.3. How can the lesson be designed to opt for using the strategies mentioned above in the case of two themes selected for exemplification?

4. Purpose of the Study

The purpose of this study is to highlight the possibility of applying strategies of active and interactive learning in the case of biology lessons in the 5th grade.

The objectives were as follows:

- Identifying how to approach the lessons concerning higher plants (Gymnosperms and Angiosperms), Fish, as well as final review, from the current manuals for the 5th grade;
- Highlighting the possibility of implementing the active learning strategy for the first lesson, and the interactive learning strategy for the next two lessons, respectively;
- Highlighting the way in which the above-mentioned lessons are used when applying the two student-centered strategies.

5. Research Methods

In order to achieve the proposed goal, we used as a research method the analysis of the curriculum and current school biology manuals developed for the 5th grade.

6. Findings

Analyzing manuals developed on the basis of the 5th grade Biology School Program in 2017, it can be said that they have a dense scientific content, sometimes with many abstract concepts, some of which were studied at high school in previous years. The content of the biology manual chosen by the teacher is to be studied by students in one hour per week. According to the order of the themes, manuals contain notions of:

- ecology, which in the years preceding the elaboration of the curriculum and the textbooks were studied in the 8th grade, but which currently complements the knowledge of the students acquired in the 3rd and 4th grades at Sciences discipline, related to different ecosystems, such as the following: the garden, the park, the orchard, the meadow, the forest, the cave, the Danube Delta, the Black Sea, etc.
- microbiology, about bacteria;
- phytopatology, about protists and fungi;
- botanics, concerning plants (mosses, ferns, gymnosperms and angiosperms);
- zoology, about animals (sponges, coelenterata, worms, molluscs, arthropods, fish, amphibians, reptiles, birds, mammals), which before the school year 2017-2018, when the new 5th grade manuals were implemented, were studied in the 6th grade.

By comparing the contents of the current manuals with the previous ones, it is found that the notions regarding bacteria, protists, fungi and plants (mosses, ferns, gymnosperms and angiosperms) are still studied in the 5th grade.

As shown in Table 01., higher plants are studied as follows:

- in a single lesson, together with lower plants (Badea, Geamănă, & Nițuleac, Mădălina, 2017; Fodor, Sună, Boldișor, & Ciuculescu, 2017; Olteanu, Giersch, Tanur, Manca, & Lazăr, 2017);
- in a single lesson (Popescu *et al.*, 2017; Sprîncenea, Ghițulescu, & Grigore, 2017; Pop-Păcurar & Podar, 2017; Stătescu & Broască, 2017);
- in two lessons (Ariniș & Popa, 2017; Crocnan, 2017; Cîrstoiu & Grasu, 2017).

Table 01. Scientific contents concerning plants and animals, existing in current biology textbooks

Nr. crt.	Manual authors / Publishing house	Lessons concerning the higher plants	Lessons concerning the Fish
1.	Popescu. <i>et al.</i> / Didactica Publishing House	Flowering plants	Poikilothermic vertebrates
2.	Badea <i>et al.</i> / S.C. Aramis Print S.R.L.	Plants	Animals
3.	Fodor <i>et al.</i> / Sigma S.R.L.	Plant (<i>Plantae</i>) Kingdom	Animal (<i>Animalia</i>) Kingdom
4.	Sprîncenea <i>et al.</i> / Ars Libri Prof S.R.L.	Gymnosperms and Angiosperms.	Fish Amfibians
5.	Olteanu <i>et al.</i> / Corint Logistic S.R.L.	Plants (mosses, ferns, gymnosperms, angiosperms)	Vertebrate animals (fish, amphibians, reptiles, birds and mammals)
6.	Ariniș and Popa / Tamar Print S.R.L.	Gymnosperms. Conifers Angiosperms	Fish Tetrapods. Amphibians
7.	Pop-Păcurar and Podar / Art Publishig Grup.	Gymnosperms and angiosperms	Fish, amphibians, reptiles, birds, mammals
8.	Crocnan / Didactical and Pedagogical Publishing House	Conifers Plants with seeds enclosed within the fruit	Fish Amphibians
9.	Stătescu and Broască / Intuitext S.R.L.	Gymnosperms. Angiosperms	Fish, amphibians, reptiles
10.	Cîrstoiu and Grasu / Letter Publishig Grup	Gymnosperms Angiosperms	Fish Amphibians

Regarding the presentation of the informational content about gymnosperms and angiosperms it can be stated that:

- in some manuals it is inductively presented - some plant species are analyzed, and finally the general characters of the group of plants are mentioned (Sprîncenea *et al.*, 2017; Crocnan, 2017);
- in other manuals it is presented deductively - the general characters of the group of plants are mentioned, and certain characteristics of some species can be observed in the images included (Popescu *et al.*, 2017; Badea *et al.*, 2017; Fodor *et al.*, 2017; Olteanu *et al.*, 2017; Ariniș and Popa, 2017; Pop-Păcurar and Podar, 2017; Stătescu. and Broască, 2017; Cîrstoiu. and Grasu, 2017).

For both categories of textbooks, the teacher can apply an active learning strategy with the possibility of processing and accessing the lesson's informational content, as well as selecting appropriate teaching methods. For a selected lesson in the first category of textbooks, they can choose the psycho-logocentric model, using various methods that actively involve learners in learning, such as observation, discovery, modeling, problem-solving, heuristic conversation, reading, etc. In the case of a selected lesson from the second category of textbooks, accentual will be more on the work of the teacher, who will have to explain

the general characteristics of gymnosperms and angiosperms. By choosing the logo-psychocentric model, in the knowledge setting phase, students may be able to solve independently and individually certain tasks by applying the exercise or the graphic organizer as teaching methods.

There is a similar situation with regard to the way knowledge is transmitted about fish. According to the data presented in Table 01, these notions are studied as follows:

- in a single lesson, in which are succinctly presented notions about invertebrate and vertebrate animals (Badea *et al.*, 2017; Fodor *et al.*, 2017);
- in a single lesson, focusing on presenting the characteristics of each group of vertebrate animals (Olteanu *et al.*, 2017; Pop-Păcurar and Podar, 2017);
- in a single lesson, in which are mentioned the characteristics and classification of poikilothermic animals: fish, amphibians, reptiles (Popescu, *et al.*, 2017; Stătescu and Broască, 2017)
- in a single lesson (Sprîncenea *et al.*, 2017; Ariniș and Popa, 2017; Crocnan, 2017; Cîrstoiu and Grasu, 2017).

In most textbooks (manuals), the final recapitulation lesson targets the main groups of animals. There are also manuals where this lesson is missing (Crocnan, 2017), or refers to the recapitulation of knowledge about vertebrates (Sprîncenea *et al.*, 2017; Ariniș and Popa, 2017).

The cooperative learning strategy can be successfully applied throughout the course of fish lessons and general recapitulation. The application of methods involving the activity of groups of students is suggested by the authors of the textbooks themselves (eg, Pop-Păcurar & Podar, 2017; Ariniș & Popa, 2017; Badea *et al.*, 2017).

To illustrate the use of an active learning strategy, in order to convey knowledge about gymnosperms in the Coniferous plants lesson, we chose Crocnan's manual. By including riddles, quotes, maxims, thoughts, or proverbs under the title of each lesson, this manual reminds us of Simionescu, who in "Zoology and Botany for Secondary Class" mentioned in every theme of zoology "a saying or a proverb about the treated animal, a fragment of a poetry known to students, or indicated, for the independent study, a reading" (Petruța, 2009, p.76).

The way in which the author presents the scientific content about gymnosperms offers the teacher the opportunity to choose different methods to stimulate both the individual learning done by the pupils, and their different types of intelligences, such as: intrapersonal, linguistic, visual, kinesthetic and musical intelligence. Thus, learning can be applied by discovery, and as methods by observation, explanation, reading, conversation, modelling. During the lesson, one can combine individual and frontal activity, using the didactic film, worksheet, drawings and coniferous branches, as a teaching aid.

The transition to the new lesson can be accomplished with the help of the riddle mentioned in the manual: "By the children is loved / For Christmas decorated / Green is, and majestic / What is so beautiful?" (Crocnan, 2017, p.108).

Next, students will be watching a didactic movie about conifers (for example, Conifers, Conifer or Pine, if a Mozaweb platform is used) or a PowerPoint presentation made by the professor. They will then be asked to complete a worksheet individually and independently with the following tasks:

1. Read carefully the text below, encircle the vegetative and multiplication organs of the plants mentioned on the text. Emphasize their characteristics.

The plants in the conifers group are woody plants, trees and shrubs. They form the conifer forests of the mountain regions. Spruce, white fir and pine trees are trees found in these forests. If we look closely at the branches of these woody plants, we notice the existence of flowers called cones, which may be smaller or larger. Because of this, they are called conifers, being the first flower plants. Flowers are propagation organs and will form seeds that are not enclosed in the fruit. Therefore, conifers are gymnosperm plants (Greek language, *gymnos* = nude, *sperma* = seed). Conifers are superior plants because they have all the vegetative organs, and they have flowers as reproductive organs.

The roots of the conifers penetrate into the ground, are branchy and branched horizontally, because in the mountain the soil layer is thin. The stem is made up of trunk and crown, with longer branches at the base and shorter at the top. On fir and spruce the crown is cone-shaped, while on the pine is irregular, with branches stretched horizontally. In the stem there are cells that produce resin, which gives these plants resistance to cold and pests. The leaves are needle-shaped and have a single rib. On the surface, they are covered with a thin layer of wax, which protects them from cold. Therefore, the leaves remain green during the winter in most conifers. In white fir, the leaves are wedge-shaped, on the other side of the branch, and have two white stripes on the lower face. In spruce, the leaves are arranged around the branch. At the pine, the leaves are long, they are placed two together. Cones are of two types: males and females. On the fir tree, the male cones have the tip down, and the female cones are large, cylindrical and have the tip pointing upwards. In spruce, female cones have a reddish color, are larger than male and are downward. At the pine, the cones are oval. With the help of the wind, the pollen from the male cones is taken to the female cones, which, after the fertilization, forms the free seeds.

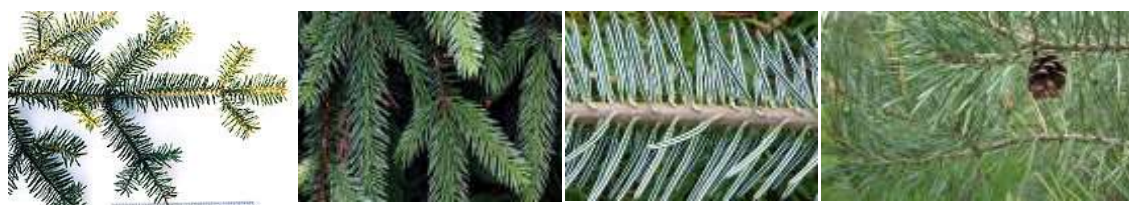
2. Considering the content of the text, identify 5 similarities and 5 distinctions between the three conifers and fill in the following table 02:

Table 02. Example

Plant name	Similarities	Distinctions
White fir		
Spruce		
Pinw		

3. Based on the reading text and the knowledge acquired in the previous lesson about ferns, mention two distinctions between these plants, which highlight the characters of coniferous superiority.

4. Observe carefully the images below, identify the plants whose branches have been presented based on the content of the text and note their name under each figure.



Source :<https://ro.wikipedia.org/>; <https://pxhere.com/>; <http://pakaretani.blogspot.com/>

Figure 01. Example of Images

5. By using plasticine, model a fragment from a branch of a conifer, at your choice.

The worksheet completed by students directed by the teacher will be discussed frontally, and the key dates will be noted in the board lesson plan. By establishing the similarities between the three coniferous species, the pupils will inductively discover the general characters of this group of plants. At the end of the lesson, students with dominant musical intelligence can sing a verse from the song "Oh, beautiful fir tree!"

In order to help students to acquire the knowledge about fish within the "Pisces" lesson from the manual developed by Sprîncenea, Ghițulescu, and Grigore (2017), the teacher can choose for a collaborative learning strategy, using the Cub and Star Explosion methods in the lesson, and as procedures, working with the manual, observation, conversation, explanation. The activity will be carried out in groups and frontally, using the manual (handbook), drawings, zoological atlas and worksheets as teaching aids.

The teacher will divide the class into six groups, and each group will have to solve by co-working and independently a task listed on one of the sides of the cube, as follows: Group 1 – to describe the living environment and shape of the body of the shark, between the cartilaginous fish; Group 2 – to compare the composition of the sturgeon body, between cartilaginous-bonefish, with those of the carp, between the bonefish; Group 3 – to identify adaptations of carp to the environment; Group 4 – to examine the consistency of the skeleton, the way of locomotion and breathing in fish; Group 5 – to identify other cartilaginous, cartilage-bone and bone fish, using the information presented in the zoological atlas; Group 6 – to argue why fish are important vertebrates for humans and aquatic ecosystems.

After discussing the results of each group, the teacher will write the lesson plan at the blackboard. At the stage of setting and systematizing knowledge, the teacher can use the Star bursting method. Students in the class will be divided into five groups and will be asked to formulate as many questions about fish as: Which? What? When? Why? Where? For example, the following sets of questions can be formulated: Group 1: What are the adaptations of carp to the environment?; Group 2: What species related to beluga do you know ?; Group 3: When does sturgeons migrate from the sea into rivers ?; Group 4: Why fish are vertebrates? Where does the sterlet live?

In the review lesson about vertebrate animals from the same manual, can be applied the strategy called Search-Think-Build, which I described in the article "The possibility of combining some interactive methods for stimulating multiple intelligences in students in biology lessons", published in 2017. During the lesson, individual activity will be combined with the group and frontal work. The graphic organizer, conversation, explanation and demonstration will be used as methods, and different teaching aids. If the student group consists of 25 students, five groups of five members will be formed, considering that five groups of animals were studied in the vertebrates: fish, amphibians, reptiles, birds and mammals. The representative of each group will extract from a bowl a ticket on which the name of a group of animals (eg birds) and an envelope with images of studied vertebrates will be written and 40 sentences referring to all 5 groups of animals recapitulated.

The envelope will contain the following images: shark, sterlet, trout, mountain triton, tortoise, tortoiseshell, lizard, house snake, swallow, duck, stork, owl, ivy owl, woodpecker, platypus, echidna, kangaroo, hedgehog, mole, rabbit, cat, horse, sheep, whale and monkey.

The set of sentences may be as follows: It is vertebrate with the cartilaginous skeleton. Is good swimmer and predator. It migrates from the sea into rivers. It lives in the fresh waters. The body is

hydrodynamic. It breath through the gill covers with openings (opercula). It lives in the mountainous area, in beech and conifers forests. It lives in terrestrial and aquatic environments. It has a thin, moist and pungent skin. Breathing is through the lungs and skin. Eggs develop through metamorphosis in the aquatic environment. The body is protected by a shell made of carapace and plastron. The skin is scaly, protecting it from dryness. It sheds. It has no members. It has no stern. It has a flattened tail with which it swims. It crawls hard on land. It's very good flyer. It's migratory. The body is shaped like a boat. It has long legs, finished with three fingers pointing forward and joined to the base by a membrane and a finger pointing back. It lives in swampy areas. The hammer is bent and sharp. It's night-captive. The head has a strong beak that catches the insects. It is represented by reptile and mammalian characters. The body is covered with modified hair in the form of short needles. It is digging underground galleries, forming molehills on the surface of the soil. It does not see well, being adapted to the underground environment. Use the forelegs to grab the food. It lives in Australia. It is a rodent animal. It moves through jumps. It's a digitigrade predator. The dentition is adapted to the carnivore diet. It is a non-ruminant herbivore. It is ruminant herbivorous. It has whalebone hairs with which he filters the plankton. It has a well-developed brain. It's big thumb is opposable.

The student representative of each group will return to the group and ask each member to retrieve 8 sentences from the envelope of their choice. Students read the statements and decide which ones refer to the target group of animals, for example, students in group 1 will establish the sentences referring to birds.

Next, the activity will take place within the groups, each of which will build a descriptive-interrogatory graphical organizer that will contain images and different sentences. Following the discussions, the group representative writes in the center of the paper / poster the name of the group of animals considered and will stick the images with the species considered to be included in it. For example, Group 1 representative will paste the images with the swallow, duck, stork, owl, ivy owl and woodpecker.

Then, it will ask each member to read the selected sentences in turn. These will be analyzed by the rest of the students in the group, and if they will appreciate that the sentences are correct, the group's representative will stick them on the paper / poster. Each member of the group will draw lines towards the personally identified sentences. Thus, each group will build a graphic organizer about the group of animals recapitulated. Next, they will think about questions that can be formulated from the sentences existing in the graphical organizer, such as: Why? The class being divided into five groups, each group will have to ask four questions for the rest of the groups. For example, Group 1 members will formulate questions for groups 2, 3, 4 and 5, such as: Why is the swallow a migratory bird? Why does the duck have the body in the form of a boat? Why does the stork have long legs, finished with three fingers pointing forward and joined to the base by a membrane and a finger pointing backwards? Why is the ivy (tawny) owl a night predator bird?

The graphic organizers of the five groups will be exposed, presented and analyzed and possibly corrected and completed. Next, the representative of each group will ask the questions asked for the other groups, and finally the winning group will be established.

7. Conclusion

Our research has highlighted the existence of different ways of presenting the contents of gymnosperms, fish, and recapitulation in current textbooks. In most textbooks, informational content on gymnosperms and angiosperms is deductively presented. A great diversity is also found in the presentation of fish informational content, being a distinct lesson in only four manuals of the ten analyzed. As far as the final recapitulation lesson is concerned, this can be found only in seven of the analyzed manuals. In two manuals, recapitulation lessons are listed after each large group of beings. The implementation of active and collaborative learning strategies is possible in the case of the lessons considered in the research, proven by the examples of didactic design presented in this article.

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