

## FORMATION AND DEVELOPMENT OF SOME CONCEPTS OF ECOLOGY

Gabriela-Paula PETRUȚA<sup>1</sup>

<sup>1</sup> University of Pitești, Department for Teacher  
Training, Pitești

e-mail: petruta\_gabriela@yahoo.com

*In the special literature of psychology and of didactics of Biology Sciences, a great importance is given to the concepts, and process for their formation. In our country, according to the curriculum of biology elaborated for gymnasium, the themes of ecology are studied during the 8th class. At the high school, the Ecology, as object of study, is studied within the program of studies in Technology. Most often, the formation and development of an ecology concept, is carried out within a series of lessons, studied during the same school year or in consecutive years. The examples presented in this paper, referring to the formation and development of concepts of "ecosystem" and "trophic pyramid" during many school years, emphasizes the importance of selecting the didactical materials and also of certain didactical methods, depending on the concrete or abstract nature of the concept.*

**Key words:** ecological concepts, abstract concepts, concepts of great generality, didactical methods, didactical materials

The concept is a notion, a general idea, which is elaborated by analysis and synthesis, abstraction and generalization, and which refers to realities, phenomena, ideas, and essential processes for building up a science [4]. In the special literature of psychology and of didactics of Biology Sciences, a great importance is given to the concepts, and process for their formation. For the psychologists, the concept occurs primarily as a process, then as a product, the concepts being considered as "systems of learned answers, which allows the organization an interpretation of the elements provided by our perceptions, and which are influencing the behavior, irrespective of the all stimuli coming from the environment, allowing us to apply automatically our past experience to the present situations" [2]. Concerning the conceptualization, M., Zlate, consider that the "The notion is formed by the progressive interiorization of practical and verbal actions, until reaching schematization and modes of mental work" [3].

### MATERIAL AND METHOD

Formation of the scientific concepts which are specific to biological sciences begins together with systematical study of Biology, as object of study, in the gymnasium. At the beginning of the 5th class, students have certain knowledges about plants, animals and humans. These notions, some of them correct, and other incorrect

are empirical concepts, that does not disappear together with the study of Biology. They are restructured, reconsidered, enriched and transformed in scientific notions. In comparison with the empirical notions, the scientific concepts specific to biological sciences, formed within the instructive-educative process carried out during gymnasium and high school, have an thorough, conscious, volunteer, and systematic content.

In our country, according to the curriculum of biology elaborated for gymnasium, the themes of ecology are studied during the 8<sup>th</sup> class [5]. At the high school, the Ecology, as object of study, is studied within the program of studies in Technology. The scientific concepts formed and developed to the students within the class of ecology are concepts of systematics, physiology, ecology, genetics, biochemistry, biophysics, etc. Analysing the themes of ecology within Biology and Ecology manuals, it can be identified ecology concepts, that can be classified having in view the following criteria:

1. After the possibility of perception with the help of senses, there are: *concrete* concepts (cell, leaf, beech forests, oak forests, coniferous forests, the lake, the Danube Delta, the Black Sea, etc.) and *abstract* concepts (adaptation, ecosystem, *biotope*, *biocenosis*, trophic pyramid, trophic relations, evolution, etc.).

2. After the two logical and fundamental elements of a notion, there are: concepts *with richer content and smaller sphere* (pine tree, hazelnut tree, deer, blue tomtil, etc.) and concepts *with more limited content and larger sphere* (conifers, bushes, mammals, birds, etc.).

3. After the degree of generality, there are concepts *of great generality* (nature, plant, animal, biosphere, etc.) and concepts *of less generality* (tree, invertebrate, vertebrate, ecosystem, etc.).

Most often, the formation and development of a scientific concept, is carried out within a series of lessons, studied during the same school year or in consecutive years, considering the relationships which can be established either with other biology concepts, or with concepts specific to other school subjects (chemistry, physics, geography, mathematics, etc). For acquirement and scientific and complete understanding of the ecology concepts, the students should to have knowledge of botanics and zoology, acquired in the previous years of school.

By knowing the types of concepts which follows to be formed at the students within a lesson, the relations which can be established between them, as well as between these, and the concepts acquired previously by the students, the teacher is able to select the most adequate ways to form and develop the ecology concepts [1]. For emphasizing the various ways used by the teacher in order to form and develop such concepts to the students, we selected the mode of formation and development of two abstract concepts: the ecosystem, and trophic pyramids, within some themes studied in gymnasium and high school.

## RESULTS AND DISCUSSION

Formation to the students of the abstract and general concept of “ecosystem” is conditioned by the formation to them of the concepts of “biotope”, and “biocenosis”, two abstract concepts, but of less generality compared to the concept of “ecosystem”. Also, formation of the concept of “biotope” is conditioned by the formation of concepts of “abiotic conditions” and “primary resources”, and formation of the concept of “biocenosis” is conditioned by the formation of concept of “population”.

The formation of these concepts begins in 8th class, within the first three themes of the Biology manual, named „The organisms’ investigation within an terrestrial environment. The park.”, „The organisms’ investigation within an aquatic environment. The swamp.” and „The biotop and the biocenosis”. For the knowledge of the environment, organisms, biological processes and phenomena, and for the correct formation of the concepts of „biotope” and „biocenosis”, is necessary to combine the lessons carried out in school, within the biology laboratory, with outdoor activities of teaching and learning, within the nature.

The formation of concept of biotope, defined as the totality of abiotic conditions (temperature, humidity, pH, oxygen, etc) in which a biocenosis exist, and primary resources (solar irradiation, water, mineral salts), by which the existence of the biological populations depends, is carried out together with the formation of concepts of abiotic conditions and primary resources. Carrying out some practical works (measurements) with the occasion of the study of terrestrial environment and aquatic environment, and also observation and analysis of the obtained results, are favoring the acquirement of knowledge about abiotic conditions and primary resources. The use of certain didactical methods – observation, conversation, explanation, demonstration and problematization – correlated with the use of some instruments and techniques specific for ecology, with which the students explore and investigate the variation of the temperature, humidity, pH, oxygen, solar irradiation, water, mineral salts etc., has an important role in the formation of these concepts.

The formation of concept of “biocenosis” defined as the totality of populations, belonging to different species, living in the same biotope, is conditioned by formation of concept of “population”. Within the class application in the field, in the nature, in the park or to the swamp, the students, initially guided by the teacher and then independently, individually or within groups, are carrying out some practical works allowing them to observe, identify and classify living organisms in the environment investigated. For instance, if the students investigate the organisms that are living within an natural (the forest) or artificial (the park) terrestrial environment, they observe the strata of the vegetation (trees, bushes, herbaceous plants and forest floor), they observe, recognize or identify the woody and herbaceous plant species, they identify the invertebrate animal species existing on soil and into the soil, within the forest floor and the herbaceous vegetation, as well as in the living or dead wood of the trees, on their leaves, flowers and bark, and they observe, recognize or identify the vertebrate animal species. Also, they observe the unequal growth of plants in height, due to the plant’s struggle for capturing the sunlight, necessary for the photosynthesis process. An important role for the correct formation of the concept of „population” have both the direct participation of students to the study of plant and animal species, and verbal guiding of the students by the teacher, aiming at the correct observation and identification of the some organisms (plants or animals) belonging to the same species found on a certain area, and carrying out analysis, synthesis and generalization of the data obtained following the observations, in order to establish

the final conclusion. Within theme „The biotope and biocenosis” it is aimed at the acquirement and scientific and complete understanding of the concepts of “biotope”, and “biocenosis”, by acquiring knowledge about relations between abiotic and biotic factors of the environment, and also about stratification on the vertical and on the horizontal of the biocenosis. For the understanding and acquirement of these concepts, are used didactical tools such as ideal models (for instance, scheme of stratification on the vertical of the vegetation within a park, scheme of stratification on the vertical of the vegetation within a swamp), and didactical methods and procedures such as: observation, conversation, learning by discovery, explanation, demonstration assisted by the computer, model devices, Clustering technique, etc.

Together with the formation of the concepts of “biotope”, and “biocenosis”, it can be considered that the students have formed themselves the scientific concept of “ecosystem”, and they understand that any ecosystem, either natural or artificial, is formed from an abiotic component (lacking of life), called biotope, and an biotic component (with life), called biocenosis. With the occasion of study of theme „Aquarium”, the teacher can verify if the students have understand the notions of “ecosystem”, “biotope”, and “biocenosis”, because the mechanical reproduction of the “ecosystem”, “biotope”, and “biocenosis” definitions does not mean always the understanding of these concepts by the students. In the 8th class, continues the development of the concept of “ecosystem” by acquiring knowledge about other natural or artificial ecosystems, such as: the Dunube, the Danube Delta, the river, the Black Sea, the forest, the bushes and meadows. In the 10th class, within chapter “Types of ecosystems and the description of the intra- and interspecific relations of them”, there is a return to the notions of “ecosystem”, “biotope” and “biocenosis”, aiming at the fixation of knowledge about ecosystem previously acquired by the students, but also the enrichment of the content of this concept, by acquiring knowledges about aquatic and terrestrial ecosystems, about natural, altered or arranged ecosystems. In the 11th class are fixed and developed the knowledges concerning the ecosystem, by aprofondation of the knowledge about relations between biotope and biocenosis within different types of ecosystems (forest, steppe, lake).

For knowing some ecosystems from other geographical regions of the Terra, or which cannot be studied concretely in the area where the school is located, the biology/ecology lessons can be organized within the museums of natural sciences, or within the classroom, using the following education tools: atlases of Botany, Zoology and Ecology, drawings, images found on the Internet or didactical films.

The concept of “trophic pyramid” is mentioned for the first time in the Biology manual for the 8th class, dedicated to the study of ecology. Formation of this abstract concept is conditioned by the formation of many other abstract concepts of lower level of generality, such as: “trophic relations”, “trophic chains”, “trophic net”, and “trophic node”. Also, formation of these concepts is conditioned by the formation of concepts of “producers”, “consumers”, “decomposers”.

The formation of concept of “producers” begins in the 5th class, when the students acquires notions concerning flowering plant nutrition, carrying out of some practical works and laboratory experiments for study the functions of vegetative organs (absorbtion, photosynthesis, respiration, transpiration). The formation of concepts of “consumers”, “decomposers” begins in 6th class, when the students acquires notions concerning the mode of carrying out the functions of nutrition of living organisms belonging to the five kingdoms. Development of the concept of “consumers” is carried out by acquiring knowledge about numerous species of animals adapted both to different environment conditions existing in the trees, on leaves and flowers, in the forest floor, on the soil or in the soil, as well as to the various modes of feeding. For the formation of concepts of “producers”, “consumers”, “decomposers”, it is used the living or conserved biological material and, predominantly, didactical methods such as: practical works, observation, conversation, explanation, demonstration, and model devices.

In the 8th class, within chapter “The trophic relations within ecosystems”, it is aiming at the enrichment of student’s knowledge about the “producers”, “consumers”, “decomposers”, at the same time with the formation of the concepts of “trophic relations”, “trophic chains”, “trophic net”, and “trophic node”, by acquiring of knowledge about the relations of feeding established among the living beings of every biocenosis, by which the circuit of the matter within the ecosystem is carried. For identify by the students the trophic relations which can be established among the species forming the biocenosis of this ecosystem,, the biology/ecology lessons can be organized within the museums of natural sciences, within the nature or within the classroom. For instance, within the class application in the field, in the nature, the students observe that the stratification of vegetation determine also a stratification of the populations of animals, for better exploiting the food resources. Within the visit at the museums of natural sciences, by analysis the figure which present the scheme of a trophic relation within an deciduous tree forest, the students observe and identify the trophic categories existing within the structure of biocenosis (producers, consumers of different ranks and decomposers), as well as the trophic relations which are established among the species forming the biocenosis, represented under the form of trophic chains. Also, they discover that numerous trophic chains of biocenosis are crossing in certain crossing points and that due to these points of contact the trophic chains are forming a trophic net. At the level of these crossing points or nodes, the students identify or recognize animal species who are consuming different food and who can act in two or more trophic chains. Together with the acquirement and scientific and complete understanding of the concept of “trophic net”, it can be considered that the students have formed theirself the scientific concept of “trophic pyramid”, and they understand that the numerical raports between the trophic levels of a biocenosis (producers, consumers of different ranks) can be graphically represented as a pyramid. In the 11th class are fixed and developed the knowledges concerning the trophic pyramid, by aprofondation of the knowledge about trophic relations and trophic chains within different types of biotopes. The use of certain didactical

methods – learning by discovery, model devices, observation, conversation, explanation, demonstration, problematization, brainwriting, and exercise, correlated with the use of some ideal models - schemes representing the trophic relation within an ecosystem, schemes representing the trophic chains which must contain one of the observed species of plants or animals, schemes representing the “trophic pyramid” within an ecosystem, graphs represented the numerical raport between the trophic levels of a biocenosis etc., has an important role in the formation of the concepts of “trophic pyramid”, “trophic relations”, “trophic chains”, “trophic net”, and “trophic node”.

## CONCLUSIONS

The analysis of the formation mode of the concept of “ecosystem”, revealed that for the formation of abstract concepts but of less generality compared to the concept of “ecosystem” (such as those of “biotope”, “abiotic conditions”, “primary resources”, “biocenosis”, “population”), it is used the living biological material and, predominantly, didactical methods such as: practical works, observation, conversation, explanation, demonstration and problematization, correlated with the use of some instruments and techniques specific for ecology, while for the formation of abstract and general concept of “ecosystem” are used didactical tools such as: ideal models didactical and predominantly didactical methods such as: observation, conversation, learning by discovery, explanation, demonstration assisted by the computer, modeling, Clustering technique, etc.

By analyzing the mode of formation and development of the abstract concept of “trophic pyramid”, is seen the formation of concepts “producers”, “consumers”, “decomposers”, during the 5th class and 6th class, and those of “trophic relations”, “trophic chains”, “trophic net”, and “trophic node”, during the 8th class. For the formation of concepts of “producers”, “consumers”, “decomposers”, it is used the biological material and, predominantly, didactical methods such as: practical works, observation, laboratory experiments conversation, explanation, demonstration, problematization, and model devices, while for the formation of the concepts of “trophic pyramid”, “trophic relations”, “trophic chains”, “trophic net”, and “trophic node are used didactical methods such as: learning by discovery, model devices, observation, conversation, explanation, demonstration, problematization, brainwriting, and exercise, correlated with the use of some ideal models - schemes and graphs.

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