# THE USE OF LEARNING MATERIALS AND MEANS IN BIOLOGY STUDIE

**Narcisa Georgeta CRISTA[1], Iasmina Cecilia SAVESCU[1]**

***Banat s University of Agricultural Sciences and Veterinary Medicine King Michael I of Romania from Timisoara***
*narcisa.crista@gmail.com*

***Abstract:*** *When studying biology, in order to acquire biologic concepts, principles, theories, laws, as well as field specific methodologies, the use of diverse learning materials and means is recommended, necessary for building biology specific general and specific competencies. This paper aims to highlight the importance of using didactic materials and means during the teaching-learning-assessing process, as well as the ways to capitalize and integrate them in the lesson. We also analyze a way to manage the material resources in biologic disciplines, useful for teachers at pre-academic as well as academic level*

***Key words*****:** *didactic material, learning means, general competencies, specific competencies, didactic design*

## INTRODUCTION

By the application of the secondary school biology curriculum by teachers, one understands following the requirements mentioned in the *Recommendation* 2006/962/EC *of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning.* In this sense, according to the secondary school biology curriculum, the capitalization of specific key competencies in the scientific field "mathematic competencies and basic science and technology competencies", as well as the capitalization of other key competencies: learning how learn, competencies in using new informational and communication technologies, social and civic competencies, communication in one's maternal language, initiative and entrepreneurship, raising cultural awareness and artistic expression. Thus, a permanent revision of didactic strategies applied in the biology study is mandatory, in the sense of facilitating general and biology competencies formation in pupils, the optimal learning methods capitalization, especially those through research and discovery, experiment, investigation, case study, demonstration and direct and active observation of organisms, biologic phenomena and processes, laboratory works etc. as well as optimizing learning materials and means for the learning objectives. This paper describes the means to achieve the planning of material resources necessary for developing didactic activities which should facilitate the formation of competencies, values and proper attitudes in pupils resulting from the secondary school biology study.

## METHODS

The current paper analyses the way in which an optimal capitalization of learning means can be achieved during biology lessons. Thus, the objectives we aimed at targeted the identification of some learning activity types where biology teachers integrate natural didactic materials or their substitutes, ways in which to optimize the material resource capitalization during biology lessons.

**RESULTS AND DISCUSSIONS**

Generally, the study of biology involves pupil acquisition of the scientific research method, respectively, the formation of a scientific way of thinking which should allow pupils to understand, analyse and discover the living world in an autonomous way, the formation of values and attitudes adequate for the scientific undertaking and applying them to the biology sciences field. The study of biology targets the development of competencies in pupils, which aim at the reception of information regarding the living world, biologic system exploration, the use and construction of models, algorithms with the purpose of demonstrating the living world principles, oral and written communication using the biology specific terminology correctly, transferring and integrating biology specific knowledge and work methods to new contexts, through study year specific competencies (secondary school biology curriculum).

CROWE ALISON et al. (2008) highlight the importance of implementing the Bloom taxonomy in order to improve biology learning, underlining the importance of applied didactic strategy change, in teaching as well as in assessment. In various speciality papers, the authors underline the necessity to centralize the didactic process on competency formation (IANCU MARIANA (2009, 2011); LAZAR V., CĂPRĂRIN D. (2008); POTOLEA, D. et al.(2008); ŞOITU, L.; CHERCIU DIANA (coord). 2006; JOITA, ELENA (2005), affirm the necessity of orienting didactic strategies towards pupils by reorganising didactic methodologies applied by teachers in class, and, implicitly, of the way to capitalize their resources in the direction of a pupil centred education.

Learning activities through research and discovery, experiment, investigation, case study, demonstration, direct and active observation of organisms, of biologic phenomena and processes, lab works need the use of learning means. According to MUCICA, T. (1982) a clear delimitation must be made between terms referring to material resources of the learning process, according to their specific content and function. The author differentiates the *intuitive material* representing objects and phenomena in their natural form, with biology disciplines these are living organisms in their natural environment or brought to class, the live biologic material being used respecting the bioethics norms: during botany lessons one can use vegetal material for the intuition of plant organs, crop plants etc.; during zoology lessons small mammal, birds, reptiles, fish, insects, worms, protozoa etc. may be used; during human anatomy and physiology lessons one can use various mammal organs as fresh material, as well as preserved biologic material (diverse collections: material in liquids, dry material, stuffed animals, microscopic material etc.). The second category is represented by the *didactic material* which encompasses, aside from intuitive material, biologic system substitutes, carried out in an intentional way in order to mediate pupil observation of objects or biologic phenomena hardly accessible or completely inaccessible to direct perception (models, installations, charts, albums, films etc.) and the third category, *learning means* which, apart from didactic material, encompass equipment and instruments used by biology teachers and pupils during the teaching, learning and assessment activity: measuring instruments, optic apparatuses, laboratory accessories, experiment and practical work apparatuses, chemical substances, accessories for the preparation and preservation of didactic material.

The teacher's creativity in choosing and integrating didactic materials in lessons may be a stimulating element in motivating pupils to study biology. Each learning means category represents an information communication modality (they hold scientific information), a way to form practical intellectual skills and to assess knowledge and skills. With their help and through learning activities, pupils learn how to describe organisms, phenomena, work methods, they learn to ask questions, to argue, to elaborate explanations. Thus, pupils have the

possibility to correlate empiric, theoretic knowledge with practical observations of the living world, their critical thinking being stimulated.

Starting from inventory of the learning means found in a biology laboratory proposed by TODOR VIRGINIA (1982, pg. 43), we believe it useful for the teachers to develop an integrated activity plan which should indicate for each study year general and specific competencies, values and attitudes, compulsory practical works and proposed learning activities, and, for each lesson, established operational objectives and the necessary learning means: the existing ones, and the ones which need to be acquired. We illustrate the plan for the 5th grade in table no. 1.

*Table 1*

Learning Means Planning

Discipline: Biology Curriculum: ……..

Grade: 5th, Teacher: ……. School year: ……..

| **Specific and general competencies** | |
|---|---|
| **Receiving information on the living world** | |
| | 1.1. Identifying some groups and species from the Plant kingdom |
| | 1.2. Establishing the relationship environment factors-plants |
| | *1.3. Observing the relationships between plants and other living beings* |
| | 1.4. Explaining the general design of a plant bearing flowers |
| **Biologic system exploration** | |
| | 2.1. Using means and methods adequate for the exploration/ investigation of the vegetal world |
| | 2.2. Accomplishing experimental activities and interpreting results |
| **Using and building models and algorithms in order to demonstrate the living world principles** | |
| | 3.1.Representing biologic system structures and functions based on models |
| **Oral and written communication using biology specific terminology correctly** | |
| | 4.1. Correct use of biology specific terminology in various communication situations |
| | 4.2. Presenting information using diverse communication methods |
| **Transferring and integrating biology specific knowledge and work methods in new contexts** | |
| | 5.1. Using vegetal biology knowledge in everyday life. |
| **Values and attitudes** | |
| Interest for scientific achievements and discoveries | |
| Motivation for scientific informing and research | |
| Developing curiosity and respect for all life forms | |
| Care for self, for others and for the environment | |
| Developing tolerance for other people's opinions | |
| Raising awareness and getting involved in global interest problems | |
| **Compulsory practical works** | |
| Optic microscope study. Microscopic observations on vegetal cells and tissues. Simple experiments to highlight the role of tissues (conductor – example, a flower coloured in ink, secretor – example, rushing rose petals/ mint leaves with one's fingers). Observations on various types of roots, stems, leaves, flowers, fruit and seeds. Highlighting the role of absorbing trichomes. Highlighting starch in the potato tubercle. Highlighting the circulation of xylem sap (example, poplar branch in methylene blue) Highlighting photosynthesis (example, through starch production in the leaf, through oxygen limination). Highlighting plant breathing (example, determining oxygen consumption, eliminating carbon dioxide). Highlighting plant perspiration. Studying seed germination. Long term observations on the environment factor influence on plant growth and development. Vegetative reproduction practical activities. Observations on bacteria, algae, fungi and lichen representatives. Observations on plants: mosses, ferns, gymnosperms-conifers, angiosperms with alimentary, medicinal, ornamental, melliferous, textile, technical, woody importance. | |
| **Proposed learning activities** | |
| Optic microscope study: optic and mechanic components of the optic microscope. Tuning and enlarging. Observations on fixed materials. Preparing some microscopic materials from *Allium* sp. and microscopic observations on vegetal cell components. Microscopic observations on vegetal tissues using fixed materials. Preparing some microscopic materials and microscopic observations on vegetal tissue and cell components: epidermis and stomata (*Tradescantia sp*. leaves), chloroplasts (moss leaf), amyloplasts (potato tubercle), cell wall (*Allium* sp. leaves). Highlighting the roles of some vegetal tissues: crushing the leaves of aromatic plants, the stem of a carnation coloured in ink, etc. Visit to the vegetable market: highlighting vegetable organs which are | |

consumed. Observations on various root types: collecting and observing some fresh roots from various common plants. Observations on various stem types – on fresh vegetal material. Highlighting xylem sap circulation: branches/stems in ink. Putting together a coloured autumn leaves herbarium. Visiting a park. Observations on leaf types. Drawing or painting leaves. Identifying tree species based on their leaves (oak, maple, linden, etc)
Highlighting spinach/nettle leaf chlorophyll. Highlighting the role of light in plant growing: *Triticum* sp. pot placed in shadow and light conditions. Highlighting plant perspiration: weighing water-filled leaves and dried leaves. Highlighting plant perspiration: covering a plant with a glass cover. Observations on flower component parts: *Lilium* sp. Flower. Microscopic observations on pollen. Observations on various types of fruit and seeds. Seed germination study with *Phaseolus* sp. and *Triticum* sp. Observations on plant growth and development with *Phaseolus* sp. and *Triticum* sp. Microscopic observations on unicellular and pluricellular plants from the water of a pond Exercises to determine some green algae, e.g. *Spirogyra* sp. Microscopic observations on *Sacharomyces* sp. and *Mucor mucedo*. Exercises to determine the main edible and poisonous mushroom species. Macroscopic study of the *Agaricus* sp. mushroom and microscopic study of its spores. Observations on lichens. Morphologic studies on mosses and ferns: fresh and pressed specimens. Observations on gymnosperms in a park. Exercises to identify some gymnosperms based on their leaves. Comparative study of dicotyledonous and monocotyledonous plant organs. Exercises to identify some common angiosperm plant species. Putting together a herbarium from 20-30 plants and exercises to determine some angiosperm plants. Carrying out some projects on the importance of plants, medicinal plants, protected plants

**Learning unit:** The vegetative organs of a plant bearing flowers

**Specific competencies:**
1.2 Establishing the relationship environment factors-plants
1.4 Explaining the general make-up of a plant bearing flowers.
2.1 Using methods and means adequate for the exploration / investigation of the vegetal world
2.2 Carrying out experimental activities and interpreting results
3.1 Biologic system structure and function representation based on models
4.1 Correct usage of biology specific terminology in diverse communication situations
4.2 Presenting information using verious communication methods
5.1 Using vegetal biology knowledge in every day life

| **Lesson title** | **Derived competencies** | **Operational objectives** | **Learning means** | |
|---|---|---|---|---|
| | | | **Current** | **Which need to be acquired** |
| Leaf functions. Photosynthesis | CD1 Explaining the photosynthesis process and establishing the relationship environment factors - plant | O1 to explain the main phenomena which take place during the photosynthesis process, underlining its importance to nature | $90^0$ alcohol, test tube, spirit lamp; schema on transparent foil; OHD-projector | *Pelargonium* leaves |
| | CD2 2.2 Carrying out experimental activities for highlighting chlorophile, and starch production through photosynthesis, light intensity influence on photosynthesis intensity and interpreting results | O2 to carry out the experiments correctly, following the teacher's instructions | activity charts, iodine solution in potassium iodide (Lugol), distilled water, ethanol, pipette, crystallizers, test tubes, glass stirrer, funnel, Berzelius glasses, electric lamps with 100W light bulbs, stand, semitransparent/ opaque screen (paper/cardboard), tinfoil, filtering paper, watch glass | Pelargonium leaves covered in tinfoil 2-3 days before, the leaves are treated with boiled water and $90^0$ boiled alcohol starch solution Elodea plants |
| | | O3 to correctly write down their observations in the work charts and to | activity charts school book colour pencils | |

| | | | | |
|---|---|---|---|---|
| | | correctly interpret them | | |
| | | O4 to argue the importance of the photosynthesis process in a plant's life and in nature | | |

The learning activities and the use of didactic materials are coordinated by the teacher through activity charts and discussions. For example, in order to highlight the starch production through photosynthesis, the work chart may contain the following tasks:

*Put the activity chart down in your notebooks!*

*Put a few iodine drops in the potassium iodide from the starch solution vessel!*

*What do you notice?(how does the starch solution colour)*

*Put your observation down in your activity chart!*

*Take the leaf out the alcohol and cleanse it a few times with distilled water! Dab the leaf with filtering paper.*

*Put the bleached pelargonium leaf in the iodine in potassium iodide vessel! Work carefully!*

*What do you notice? (how does the starch solution colour, what colour does the pelargonium leaf become)*

*Fill in the activity chart!*

*What conclusion do we draw from the carried out observations?*

Analysing various biology discipline lesson plans from the specialty literature we generally established a weak explanation of the way in which learning means are integrated and capitalized during the lesson. As LAZĂR V. & DANIELA CĂPRĂRIN (2008) affirm in the above quoted paper, the efficacy of using learning means depends a lot on users (teachers and pupils), and not only on their intrinsic quality, thus making a teacher preparation reorienting necessary towards the ways of using technical instruction means, apart from didactic methods. The same authors identify the main difficulties which appear when using didactic means: insufficiently rigorous didactic projection, a lack in coherence of the proposed activities, a lack in coherence between objectives, contents, methodology and learning means, insufficient practical teacher training in the use of didactic means, the defective organization in distributing, organizing and leading learning activities, observations, demonstrations, explanations and insufficient comments, improper time dosage.

Thus, the integration of didactic means in a biology lesson supposes a rigorous analysis of competencies to be acquired by the pupils, of lesson objectives, of taught contents, of pupils' psycho-individual particularities and their age.

## CONCLUSIONS

The pure existence of didactic materials does not insure efficacy in learning without a coherent organization of learning activities, the efficient capitalization of didactic means being insured by a judicious didactic projection achieved by the teacher.

The elaboration of a learning means planning facilitates the organization and development of learning activities adequate for the envisioned competencies, the applied didactic strategies, contents and allotted time.

The modernization and adaptation to current society needs of the entire learning process must be achieved systemically, integrated, starting from the rethinking of school

curricula, taught contents, didactic strategies applied in teaching and assessment and, implicitly, of the material and financial resources allotted to biology teaching.

**BIBLIOGRAFY**

1.CROWE ALISON, DIRKS CLARISSA, WENDEROTH MARY PAT, 2008 - *Biology in Bloom: Implementing Bloom`s Taxonomy to Enhance Student Learning in Biology*, CBE – Life Sciences Education, Vol. 7, 368-381, 2008

2.IANCU MARIANA CIOBANU, 2009 - *Pedagogie aplicată în ştiinţele naturii* [Pedagogy Applied in Natural Sciences], Editura Corint, Bucureşti

3.IANCU MARIANA, 2011 - *Pedagogie aplicată - Domeniile de competenţe cheie europene în perspectiva disciplinei Biologie* [Applied Pedagogy – European Key Competency Fields from the Biology Discipline Perspective], Editura Didactică şi Pedagogică, R.A., Bucureşti

4.JOITA, ELENA, 2005 - Strategii constructiviste în formarea iniţială a profesorului, vol I. [Constructive Strategies for the Initial Teacher Formation, Vol. I] *Ed. Universitaria, Craiova*

5.LAZAR V, CĂPRĂRIN D., 2008 - *Metode didactice utilizate în predarea biologiei* [Didactic Methods Used in Biology Teaching], Editura Arves

6.MUCICA, T. (coord), 1982 - *Îndrumător metodic pentru folosirea mijloacelor de învăţământ*, [Methodological Guidebook for the Use of Learning Means], Editura Didactică şi Pedagogică, Bucureşti;

7.POTOLEA, D.; NEACSU, I.; IUCU, R., 2008 - *Pregatirea psihopedagogică. Manual pentru definitivat şi graduldidactic II* [Psycho-pedagogic Training. A Textbook for Definitive Didactic Degree and Second Didactic Degree], Editura Polirom, Iaşi

8.TODOR VIRGINIA; ECATERINA CSENGERI; ELISABETA MÂNDRUŞCA; AGLAIA IONEL; GAVRILĂ, I.; VICTORIA NEGULESCU;VEREŞEZAN A., 1982 - *Metodica predării ştiinţelor biologice* [Biology Science Teaching Methodology], Editura Didactică şi Pedagogică, Bucureşti;

9.ŞOITU, L.; CHERCIU DIANA (coord.), 2006 - *Strategii educaţionale centrate pe elev* [Pupil Oriented Educational Strategies], *Alpha MDN, Buzău*

10.xxx- *Programa şcolară de biologie clasele V-VIII*, in vigoare, disponibilă pe www.edu.ro [Grade V-VIII Biology Class Curricula, in force, available on www.edu.ro]

11.xxxx - *Recommendation* 2006/962/EC *of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning,* Official Journal of the European Union