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THE REFLECTION AND THE FORMING BIOLOGY EDUCATION'S GOALS

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ABSTRACT. This article is an attempt to reconsider of the traditional view how to form and realize the goals in biological education at 9th grade using the newest achievements in Philosophy, Logics, Psychology, and Pedagogy. Our starting point is that the ability to form and realize goals is directly connected with the formation of self-consciousness and personality and therefore the reflection is reliable mechanism which is able to ensure necessary interaction between the cultural-historical experience, moderated by the educational content of biology and the personal experience of the student. We found a possible source and factor for its more effective manifestation and development in the direction of the aim generation to the reflection on the cognitive activity in the educational process in Biology.
A theoretical model of the goals of the education in Biology 9th grade was created by recognizing the unity between the declarative and procedural knowledge, and the level of the productivity of the reflection. The model was focused on the thematic part „Cell" to the level of the intermediate goals with priority on their control-estimative function.

KEY WORDS. reflection, forming educational goals, biology education.

Reflection is an active thought procedure that is consciously directed towards self-knowledge – towards knowing one's own cognitive activity (Dewey, 1997) and the qualities of the personality (Stepanov et al., 1983).

The pedagogues'increased interest in the problem of the purposeful formation of reflection comes from its various functions in teaching. It is in the foundation of the intellectual development and the student's individual growth, it makes

communication between characters easier and creates conditions for better synchronization of theory and practice. It is considered that reflection is one of the best „mechanisms“ for the fulfillment of self- knowledge teaching, highlighting expression and self-development of student's individual potential (Bondarevskaja, et al. 1999). That is why teaching-specialists look for new ways and prepare practical programs (models, technologies and other) based on the ideas of reflection or goal-oriented towards its activation in the process of teaching. Important role in these programs is given to the organization of different mental processes, updating the manifestations of reflection, including goal-formation, which is characteristic for the teacher.

Goal-formation is closely connected with the forming of the higher under-structures of the personality, including self-knowledge. The term *goal-formation* describes the process of determination and formulation of pedagogic goals and their consideration by the student (Nikolov, 1987, p.7). Because of the partial coincidence of goals and motives in acts of behaviour, goal-formation is closely related to the problem of *motivation* in teaching. It is frequently interpreted as a process that is added to goal-formation because via it the personality chooses and acts to achieve rationalized goals or refrains from acts. When one sets certain goals he analyses and estimates his personal abilities, compares his qualities to the achieved results from a certain act, which is a manifestation of reflection. In this aspect goal-formation is also a reflective process (Nikolov, 1987; Hutorskoy, 2001).

The processes *goal-setting*, *goal-forming* and *goal-realizing* are delimited in pedagogy. Goal- setting is normatively bound and includes the formulation and the realization of the goals of the teaching on the relevant subject. The teacher usually takes part in the discussion on the goals and is thoroughly engaged in goal-realization, while the student most frequently takes part in goal-realization (Panajotov, 1999).

In this article we give reasons for the necessity of constructing a theoretical model guiding the processes goal-formulating and goal-realization of the teacher to the reflection of the student (highlighting on the reflection on the cognitive activity) in the teaching on biology in 9^{th} grade. With the model we have constructed we are looking for a way to a „reflective“ enrichment of the motivational- goal component of teaching on the subject and for projecting methods by which to effectively realize the goals or to make diagnostics on their achievement.

An objective base for the orientation of these processes, are the newest international documents on the development of the biological education and the recently accepted state documents on the teaching on „Biology and Health Education“. The subject is studied in high school in Bulgaria and is part of the subjects from the cultural-educational field „Nature science and ecology“, differentiated in the curriculum and syllabus. Generally it describes the increasing tendency in science towards humanization of the relations „Human-Human“, „Human-Nature“, „Human-Society“. This tendency finds its concrete expression in the enrichment of the material on the subject „Biology and Health Education“ 9^{th} grade with new valuable aspects on the biological knowledge and adds new elements

in the goals of the teaching on the subject. The revival of the ideas of the humanistic pedagogy sets forth the development of the student as an active personality with a unique individuality and potentials for self-knowledge and self-realization. Highlighted is the necessity of gaining important experiences in the form of knowledge, skills and attitude to nature and human (Panajotov, 1999; Stavreva, 2002).

Actually, the biology-teaching „mission" is still connected with gaining a certain normatively given combination of ready socialized results, astray from the way and methods for their achievement by the students. The questions connected with the formation of valuable attitude to the objects educated, the knowledge and the actions needed for gaining the knowledge stay in the margins of the teaching process (Stavreva, 2002). The problems of goal-setting of the personality's psychic qualities, the methods of self-organization and self-development, of virtue- arrangement and orientation in the process of biological education, need to be solved.

The national educational standards and the curriculum for biology and health education 9th year are the reason for guiding the goal-formulation and goal-realization. The *basic goals* of the teaching of the relevant subject are normatively stated in the curriculum. They project the forms of knowledge and skills which the students are expected to master as elements of biological culture. The content of the basic goals is determined by the specific individual knowledge didactically put in the educational content.

According to the *basic goals of the teaching* on the subject „Biology and Health Education" 9th class, the students are expected to:

- gain knowledge of structures and processes that take place in macro and micro systems, of molecular-cellular and super- organic level of organization of living nature by which to form their own biological culture and value-system
- gain skills to put their knowledge of other subjects to work when characterizing the micro and macro systems on structural and functional basis;
- gain skills for leading a healthy lifestyle and natural behaviour
- form a value-attitude to natural resources in connection with the necessity for their reasonable use and restoration (Educational Syllabus, Part II, 2000).

The effective realization of the normatively given basic goals is achievable when the student shows a high, mostly inner (sensorial, intellectual, emotional) activity. *Activity* is a cognitive quality of the personality and is manifested as a necessary condition for the beginning and expression of *consciousness* (Pirjov, 2000; 8, p. 201-203), and the last is a precondition for the increase of activity and independence (Nikov, 1996, p. 106). In its turn, the quality *independence*, interpreted „through the prism of the teaching goals" influences and helps the active mastering and development of the knowledge, skills, conceptions, notions, and convictions through the conscious activity of the student (Panajotov, 1999, p. 154 – 155). The interaction between the qualities activity, consciousness and independence gives good opportunities for achieving the expected goals of the teaching on „Biology and Health Education" 9th grade.

It is necessary to point out that the cognitive qualities activity, consciousness and independence are conditions for activating the reflection and for manifestation of the *reflectivity*. This quality helps the individual realize as a subjective the objective relation „subject-object“, to achieve different forms of conscious subjective attitude (personal sense, personal position, value orientation and other). High inner activity, high consciousness (Dimova, 2001, p. 81) and high cognitive independence are needed in order to form and confirm reflectivity as a valuable personal quality. The result of their deliberate formation and development is connected with enrichment of the value-meaning sphere and the contents of the „Self-concept“ of the student.

These and some other personal alterations are achievable if the goals of the biology teaching plan not only active an independent educative work (as it is now in the educational program) but they also expect it to run more effectively with the maximum help of the student's own experience. It may be stated that this effect is achievable if the *processes of goal-formulation and goal-realization* of the teacher are oriented towards not just the concrete biology educational contents, i.e. towards the forming declarative and procedural knowledge, but also towards the activity connected with their mastering, i.e. towards reflection over the cognitive experience. This means that the reasoning (contemplations on own cognitive actions in time of or after their completion, the reasons and sources of their own thoughts etc.) should be helped, controlled and encouraged, but not only to keep an eye on the correct result from the organized intellectual or practical activity (Vasilev, 2000, p. 240).

It should be pointed out that goal- formation highlighting reflection could stimulate the formation of outer positive motives for studying and their transformation into inner, sense- forming motives of the subject. In this way the personal potential of the student is better developed, self-alteration and self-development are encouraged, better realized are not only the educational, but also the developing goals of education, alongside with the provided in this way conditions for a higher effectiveness of the educative process (Nikolov, 1987).

The above-mentioned considerations are in the base of the constructed by us *theoretic model* reflecting the cognitive characteristic features of the *goals of the education on Biology and Health Education* 9^{th} *grade* (scheme 1). The basic idea when constructing this model was to orient the goal-formation process towards activating the student's reflection over his/her own cognitive activity when studying the „Cells“ section in the relevant educational course. The classic principle of unity of the declarative and procedural knowledge is respected.

Scheme 1. Theoretical model of the goals of the teaching on Biology and Health Education, 9th class, section „Cell".

Cognitive characteristic of the goals of the teaching			
Empiric (sense-concrete) knowledge and actions →		Empiric-theoretical (abstract-logic) knowledge and actions	
Reproductive thinking **(with elements of productive thinking)** →		Productive thinking **(with elements of creative thinking)**	
Satisfactory	**Good**	**Very good**	Excellent
Actions with accent on reproduction →	**Actions with accent on understanding** →	**Actions with accent on application in analogous situations** →	**Actions with accent on application in unknown situations**
naming, choice, description, recognition on sense support	analysis, comparison, classification, characterizing, making general conclusions	analysis and synthesis, deducing regularities, proof of statements	modulating, formulating and proving hypothesis, planning, predictions
Forms of knowledge →	**Forms of knowledge** →	**Forms of knowledge** →	**Forms of knowledge**
different indications or complex of indications; facts, simple reasoning.	complex of indications, multiple objects from a class, empiric concepts, simple and complex reasoning.	theoretical concepts, complex reasoning and conclusions.	biological regularities, leading ideas, predictions

The presented model expects to give answers to the question „How and what should the students learn as a result of their biological education? " It is made of hierarchically arranged fragments, which characterize (Stavreva, 2002):

1. The *relevant level of cognition* with adequate knowledge and activities;
2. The *type of thinking* which they define;
3. The *level of teaching*;
4. The *intellectual and practical actions* (*procedural knowledge*), adequate to the relevant *forms of knowledge* (*declarative knowledge*).

The model gives priority to the control-estimating function of the goals of the teaching and concretizes them in thematic directions to the level *intermediate* (*thematically*) *goals*. They correspond to the object field of the biological knowledge, didactically transformed in the educational material. In its construction, section „Cell" („Micro- system- structure and processes") is differentiated as an independent module and has goals, specific in their contents and functions. They refer to the morphological and functional aspects which reflect the whole characteristic of the micro-bio-system cell and are subdued to the basic goals of the teaching on the subject „Biology and Health Education" 9th year.

On the basis of this theoretical model and the educational material from the compulsory education in chart 1 is extracted the contents of *the educational and developing goals* of the section (Kolarova, 2003). They are arranged hierarchically in four levels which are relevant to the following basic cognitive processes (Dimova, et al., 2004): *reproduction* (memory process which binds the actual experience with the preceding one), *understanding* (thought process which achieves a differentiated

scheme – meaning, sense), *reflection* (thought process which achieves deepening and rationalization of the understanding by taking the person to known and unknown situations).

Table 1. Block of educational and developing goals of the section „Cell" („Micro- system-structure and processes") , pointed towards the student, subject to control and estimation

Declarative and procedural knowledge	
1	**2**
Reproduction • *To enumerate*	*essential indications* of: groups of chemical elements and chemical compounds taking part in the composition of the cell; functional chemical groups taking part in the composition of the bio- molecules; basic groups biopolymers; kinds of over- molecule complexes and cell structures ; types and kinds of cells; basic genetic processes and their relevant stages; types and kinds of metabolic processes with their relevant stages; basic forms of cell-division (mitosis and meiosis) and their stages; virus and bacterial diseases.
• *To name*	represented in different forms (in pictures and words) *objects* – levels of micro- bio- system organization, chemical elements in the composition of the cell, monomer units of the biopolymers (carbohydrates, proteins and nucleic acids), kinds of over- molecule complexes (bio- membranes, ribosome, chromatin, viruses etc.) kinds of cytoplasmic organelles and cells with the scientific terminology.
• *To define*	*concepts*: biopolymers – carbohydrates, proteins, nucleic acids; DNA; RNA; enzymes; over-molecule complexes; cytoplasmic organelles – membrane and over- membrane; cell; prokaryote cell; eukaryote cell; gene; genetic code; complementary base pairs; matrix principle; genetic processes – replication, transcription and translation; metabolism; metabolic processes – anabolic and catabolic processes, biological oxygenation and oxygen phosphorus; cell division – mitosis and meiosis, cell cycle; cell differentiation.
• *To describe*	the structure, properties and functions of the water molecule, carbohydrates, lipids, proteins and nucleic acids; the necessary conditions for enzyme operation and the application of the enzymes in practice; the composition and the cycle of viruses' reproduction; the diffusion, the form and general composition of prokaryote cell; the form, the size and the principle composition of eukaryote cell; the composition and the functions of the cytoplasmic membrane, cytoplasmic organelles and cell nucleus; the transfer directions of the genetic information, the basic principles and mechanisms of genetic processes; the phases of photosynthesis and the stages of the glucose cyclic; phases of meiosis and mitosis.
• *To distinguish*	organic compound (lipids, carbohydrates, proteins and nucleic acids; cytoplasmic organelles, cell nucleus and nuclear structures, cells (prokaryote, eukaryote), processes and stages (phases) of the cell processes – trafficking through the membrane; storing and transfer of genetic information, exchange of substances and energy between the cell and the environment, cell division, shown as a text, description, scheme or on a microscope photo.
• *To mark*	on a scheme or model, using symbols: the common formulae of the monomers in the structure of the proteins and the nucleic acids, the structure of the plasma membrane, structure of cytoplasmic organelles; the mechanism of enzyme operation; structure of prokaryote and eukaryote cells; the mechanism and basic stages of cell processes (active and passive transport, genetic, and metabolic processes, cell division), exit compounds and final products of a concrete metabolism.
Understanding • *To determine*	by *essential indications*: basic groups of organic compounds, homo- and hetero-biopolymers, cell organelles, types and kinds of cells, kinds of genetic processes, anabolic and catabolic processes, mitotic and meiotic division, given as a text, two- dimensional, three- dimensional.
• *To compare*	by *chosen indications biological objects, concepts or conceptions' systems* for these objects, levels of micro- bio- system organization, chemical composition of living and nonliving

	nature; types of organic compounds, homo- and hetero- biopolymers, fibril and globular proteins, DNA and RNA, kinds of RNA, chemical and biological catalysts, reversible and nonreversible inhibition, viruses and cells, prokaryote and eukaryote cells, active and passive transport, membrane and non- membrane organelles, chromatin and chromosomes, basic genetic processes, catabolism and anabolism, light and dark phases of photosynthesis, glucose cyclic and Krebs' cycle, photosynthesis and aerobic biological oxygenize, amitosis and mitosis, mitotic and meiotic division.
• *To classify*	really and figuratively shown *objects*, *processes* or *biological concepts* for them in a system on the basis of certain indications: chemical elements, by the percentage of their contents in the cell, organic compounds depending on their possibility to hydrolyze, biopolymers – on the basis of the number and kind of the monomers; organelles according to the presence of a membrane, organisms – according to the type of exchange; metabolic processes depending on the energy source or the character of the oxygen processes.
• *To analyze*	as fully as possible the basic periods in the history of the cell teaching, the basic terms of the cell theory and the theory of the multilevel organization of living matter; chemical composition of the cell; the structure of water molecule, structure and functions of the basic groups of chemical compounds, the structure and the cycle of the viruses' reproduction, methods applied when studying the levels of organization of the cell, morphology and structure of the prokaryote and eukaryote cells, structure and function of cytoplasmic organelles (non- membrane and membrane), location, form and size of the cell nucleus, mechanisms of condensation of chromatin, the directions of transfer of the genetic information, basic principles and basic stages in genetic processes, types of metabolism, stages of the catabolism, light and dark phase of photosynthesis, phases of mitotic division and stages of the process meiosis.
• *To explain*	the properties and significance of the elements C, H, O, N in the organic and non- organic compounds for the living nature; properties and functions of the biopolymers; chemical nature of the enzymes and the mechanism of enzyme operation, biological role of the over-molecule complexes, mechanism of AIDS infection; basic life processes for prokaryotes, the link between the composition and the functions of all cell components, mechanisms of the kinds of the membrane trafficking ; location, stages, mechanism, conditions, results and the biological sense of genetic processes, of anabolic and catabolic processes, of the biological oxygenize and oxidative phosphorylation; of the mechanism and the biological sense of the mitosis, meiosis and cell differentiation.
• *To deduce*	*partial summaries* for: the connection between the structure, properties and functions of cell structures, the connections between single-membrane cytoplasmic organelles, the connection between the cell nucleus and the cytoplasm in the cell; the connection between the conditions and the final results of the cell processes, also between the different stages (phases) of the processes (light-dark phase of photosynthesis, biological oxygenize and oxidative phosphorylation, glucose cycle- Krebs' cycle; preparatory phase of mitosis-mitotic division).
• *To illustrate*	*with concrete examples* the meaning of the molecular components for the existence and diversity of the bio- systems; the diversity in proteins; the application of the enzymes in practice; the morphological diversity of the cells` nuclei in the eukaryote cell and the cells; diseases in humans caused by viruses and pathogenic microorganisms; ways of infection and injuring the organism; the different types metabolism and energy exchange between the cell and environment; types of transporting substances through the membrane; the chromosome number; diploid and haploid chromosome set.
• *To objectivise*	in correct order stages or phases of the processes in the micro-biosystem (genetic and metabolic processes, mitotic, meiotic division) according description, scheme or photo.
▪ **Application in analogycal situations**	
• *To define*	*criteria* for grouping studied or not studied cell structures and cell processes on a definite base, suggested by the teacher or chosen by the student.

• *To apply*	*acquired algorithm in forming concepts*, characterizing the structure of the cell (e.g. composition – structure – property – functions); in forming concepts for metabolic, genetic processes, and cell division (e.g. exit substances – conditions – mechanism – end products-biological and anthropomorphic distinction of the process) etc.
• *To model*	*fragments* of polypeptide chains of the protein molecules; parts of polynucleotide chains of DNA and RNA upon the basis of the complementary of the nitrogen bases.
• *To build*	*hierarchical system of acquired biological concepts* on chosen basis (eg. cytoplasmic organelles– on morphological or functional basis; types of cells on taxonomic basis; metabolic processes according the energy source).
• *To analyze*	the reasons for resemblance and difference between the animate and inanimate nature on the level of chemical elements and chemical compounds, between the eukaryotic plant and eukaryotic animal cell the setting of unified membrane system in the cell, denaturation and renaturation of the proteins, the specification of the enzyme activity, the changes in the osmotic behavior of the cells, condensation of the of the chromatin and reducing the chromosome in the cell division; the meaning of the within molecular identification and self-assembling of over- molecule complexes; the role of the matrix principal and the rule for complementary base pairs for fulfilling genetic processes; the biological meaning of the genetic code for the diversity and the development of organism world; the necessity and the conditions for carrying out the metabolism in the cell.
• *To give proof of*	*the natural connections* among the composition, structure, property and functions on every level of organization of the micro-biosystem and cell as a whole; the interaction between the organelles in the cell, between the cellular nucleus and the cytoplasm; the natural connections between the cell and the environment; the connection between the conditions and the results of cell processes, between the stages and between the separate processes; the role of the ATF for the energy usage in the cell; the biological role for every studied process for the existence and functioning of unite micro-biosystem; precautions for protection of viruses in humans; the fundamental importance of the cell theory for the development of the strictly biological science; the application of the discoveries in the field of the cell and molecular biology.
• *To prove*	the material unity of the animate nature through the cell structure of the organisms; the unity of the origin of the organisms and their connection with the inanimate nature through the chemical structure of the cell; the bio- chemical resemblance and differences of the animate and inanimate nature; the role of the prokaryotes and viruses for the nature and humans; the structural unity of the cell and cell processes; the cell as an elementary bio- system having basic symptoms of life.
• *To give argument of*	the *belonging* of concrete biological object or group – cell structure and cell processes (presented in semantic or schematic form) to given biological concept or concept system by essential indications, on a certain basis.
• *To evaluate*	on the base of argumentation *produced evidence* for: the structure functional unity of cell structures, the micro-biosystem as an unity; the role of the information hetero- biopolymers; the genetic function of nucleic acids etc.
• *To introduce*	*results* (in pictures and words) from realized experiments and observations upon: the chemical structure of the cell morphological variety and structural features of prokaryote and eukaryote cells; phases of meiosis division; proving the influence of different factors on the photosynthesis etc.
• *To summarize*	*results* from realized biological experiments (real and mental) and observations of objects and processes in the cell making a natural connections and subordinations (e.g. the connection between structure, quality and functions of the cell organelles; the subordination between conditions and results from the cell processes etc.).

• *To construct*	*problem question* (in labial or in written form) requiring as a reasoned answer unification of some coherent ratiocinations for cell structures and cell processes.
• *To formulate*	*well-founded answer* (in labial or in written form) generalizing the content of several problem questions for the character of cell structures and cell processes.
• *To transform*	content of a text about cell structures and cell processes into scheme, table, and vice versa.
▪ **Application in unfamiliar situations**	
• *To search*	*information* in unknown text *for proving:* connections characterizing the different levels of organization in the cell; connections between cell structures, relations of identity and difference between cell processes, connections between stages and phases of these processes etc.
• *To separate*	in *logical fragments* unfamiliar text for cell structures and cell processes.
• *To formulate*	*title* for text or model representing not studied cell structures and cell processes.
• *To compare*	the *content* of thematic connected blocks of information for unfamiliar cell structures and cell processes.
• *To resume*	the *contents of unfamiliar text* (or scheme, illustration, photo, etc.) for cell structures and cell processes by taking (in labial or in written form) the main idea, themes or sub-themes of the text.
• *To supplement*	the *content of unfamiliar text* (including table or model) through reasoned assertions for cell structures and cell processes.
• To edit	the *content of unfamiliar text* for cell structures and cell processes (including from popular literature).
• *To review*	the *content of unfamiliar text* for cell structures and cell processes, based on criteria given by the teacher and formulated by the student.
• *To conspect*	the *content of unfamiliar text* (including from popular literature) for cell structures and cell processes by choosing a theme given by the teacher or chosen by the student (e.g. by developing projects, essay, etc.).
• *To model*	upon given standard (presented in a scheme or in a word) *structures and processes* on the different levels of micro-biosystem (for example plan for the structure of prokaryote cell and eukaryote cell, type of membrane trafficking; phases of mitosis, etc.).
• *To formulate*	*hypothesis* for biological functions of the cell components based on the characteristics and structure of those components or the opposite; hypothesis for conveyance different substances between the cell and nature; hypothesis for creation of unit membrane system in the cell; hypothesis for the eventual consequences for the cell if the nucleus is taken away; hypothesis for the possible reasons for the cell to grow old etc.
• *To plan*	the necessary *activities* (intellectual and practical) *for theoretical researches* of unknown cell structures and cell processes or for carrying out an biological experiment (real or mental) for their study.
• *To prognosticate*	*the possible changes* in the cell components, mechanisms and the results of cell processes because of different factors on those processes and the possible reasons (for example possible „mistakes“ in the replication mechanism and transcription when the complementary

	rule is breached; breaches in the mitosis when the nucleus or the cytoplasm is not divided etc.)
• *To evaluate*	*alternative explanations*, *hypothesis, proofs* or *prognosis* for the characteristics, functions of cell structures, the biological and anthropomorphic importance of cell processes based on inner criteria (e. g. argumentation, logicality of the exposition, etc.).

Basic for the building of the block of main aims of the section „Cell" is the principal of the unity of the declarative and operational (procedural) elements of the biology knowledge. In the hierarchical putting the goals, given as activities of the student we pay special attention on those of them, which plan application (transfer) of the knowledge in known and unknown situations (for example in the area of the hypothesis, prognosis, evaluations of unstudied biological objects). The knowledge activities, required application in unfamiliar situations guide the student to realize the ways throughout which the knowledge functions, i.e. character of the activity connected with acquiring the procedural knowledge. So, is ensured terms for orientation of teacher's goal-forming toward actualizing the students' reflection under the cognitive activity, as well toward developing general learning skills and specific skills in the teaching biology. We will add that the indicators in presented block (defined as cognitive actions) give ideas for defining tasks through which can be realize formulated aims and may be diagnosed their achieving. An earlier experiment of ours proved the rich possibilities that the combination of indicators offers to create a reliable and valid instruments for measuring the reflection's productiveness in biology education (Kolarova, 2003).

In conclusion we will add that the conscious guiding the goal getting to the intellectual reflection should be an important task in school education not only in biology but in the other subjects also. Undoubtedly, reflection has precious potential for self- realization, self- development and self- perfection of the student.

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