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## Periodicity of Professional Pedagogical Education within Bachelor's and Master's Programmes in Natural Sciences

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**Abstract:**

*The article provides grounding and a methodological macro-development basis for a system periodic model of professional pedagogical education within bachelor's and master's programmes in natural sciences. In the abovementioned context, periodicity is regarded as a universally applicable procedural basis for multilevel continuous professional pedagogical education in the sphere of natural sciences. A key category of system periodic model of professional pedagogical education within bachelor's and master's programmes in natural sciences is a didactic cycle characterised by purposefulness, internal system integrity, dynamism, iterativity, controllability and hierarchy of levels based on phase logic. Didactic cycle is represented as a dual procedure of development of subject-subject relations oriented to correlation changes of self-balancing systems depending on quantitative augmentation in a form of grasping of content of professional pedagogical education within bachelor's and master's programmes in natural sciences to qualitative personal transformations. Realisation of the hierarchy position is realised as macro-didactic, meso-didactic and micro-didactic cycles within the structure of a system model. Their attributive signs are goals, peculiarities of learning activity within the process of subject-subject dialogic interaction, types of solved tasks and performance. We have defined and characterised specificity of phases of didactic cycle: initiatives and perspectives, designing, implementation, assessment of results.*

**Key Words:** *periodicity, system periodic model, professional pedagogical education, Bachelor's programme, Master's programme, natural sciences, didactic cycle, phases of cycle.*

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## **Introduction**

Periodicity is manifested in natural environment, as well as economic and social spheres of human life. Professional pedagogical education as a social institute perfectly manifests all the modern trends of social and cultural development. Under the conditions of boosting of globalisation processes, a historically formed system of traditional professional education of teachers based on consistency of its structure and content does not comply with modern demands of a person, society and a state anymore.

Modern procedures conditioned by implementation of the ideology of the Bologna process and integration of Russian higher education system into global education space are manifested in professional education of teachers. Abovementioned processes are associated with expansion of functional value and the structure of higher education of teachers, its competency orientation and level differentiation, with establishment of credit system, profilisation, application of ideas of periodicity of educational process, modular content structuring, variability, closer attention to pedagogic conditions of its organisation, feasibility.

### **Periodic Model of Professional Pedagogical Education within Bachelor's and Master's Programmes in Natural Sciences**

The authors have developed and implemented a system periodic model of professional pedagogical education within bachelor's and master's programmes in natural sciences (biology, chemistry, geography, health and wellness, ecology). In the course of scientific inquiry of professional pedagogics we applied a phenomenon of macro-development as a specific stage of development of a complex system of higher pedagogic education. A separate place in its structure is occupied by natural sciences and bachelor's and master's programmes, characterised by continuity, multiple levels and periodicity, corresponding to conditions of academic mobility and networking cooperation [9].

Within present research, macro-development is aimed at grounding of system periodicity of the model of professional pedagogical education within bachelor's and master's programmes in natural sciences, determination of key qualitative and quantitative characteristics of the functional structure of the model providing its efficacy and performance.

Based on the approach developed by N.M. Borgest, we have effected macro-development of system periodicity model of professional pedagogical education within bachelor's and master's programmes in natural sciences in conceptual and draft form [6, p. 18].

Conceptual design of system periodicity model of professional pedagogical education within bachelor's and master's programmes in natural sciences implied development of the concept (avant-project) based on ideology of periodicity of educa-

tional process studied in details by Americans (David Kolb and his colleagues from Case Western Reserve University) and Russian scientists (Yu.K. Babanskiy, A.M. Danilov, L.Ya. Zorina, B.I. Korotaev, A.E. Maron, P.I. Pidkasistyi) [2, 7, 8, 11, 12, 13]. Periodicity is regarded by the authors as universally applicable procedural basis for multilevel continuous professional pedagogical education in the sphere of natural sciences.

The model is not a static construction, it is dynamic and it allows the pedagogic process to evolve. Hence, developed model is characterised by integrity, purposefulness and functional structuredness. The state on the integrity of developed model of professional pedagogical education within bachelor's and master's programmes in natural sciences indicates its consistency determined by the laws of harmony and balance, interelement functional coordination and correlation. Integrity as a manifestation of emergence establishes fundamental irreducibility of properties of integral model to the total of properties of its elements, as well as nonderivability of the integral from the latter properties; dependence of each element, property and relations of the model on its place and functions within the integral. Integrity of the model is characterised by new qualities and properties extrinsic to its separate elements but arising as a result of their interaction within a certain system of relations.

Purposefulness acts as a core factor determined by certain social and government demand for qualified teachers of biology, chemistry, geography, health and wellness, ecology, ready to and capable of efficient pedagogic activity, as well as by personal needs of students regarding this sphere as a significant condition of their competitive ability and success in professional sphere.

Functional structuredness of model complies with modern level organisation of professional pedagogical education and is represented by interconnected levels "bachelor – master" in the form of didactic cycles changing each other.

It is the definition of a didactic cycle that is a crucial one in abovementioned system of professional pedagogical education within bachelor's and master's programmes in natural sciences. Didactic cycle is represented as dual procedure of development of subject-subject relations oriented to correlation changes of self-balancing systems depending on quantitative augmentation in a form of grasping of content of professional pedagogical education within bachelor's and master's programmes in natural sciences to qualitative personal transformations.

In regard to the procedural structure, each didactic cycle of the system model is characterised by phase logic. At this, the beginning of one phase flows organically from the preceding, and its ending causes the next one. The fundamental aspect is a presence of micro-result at each phase of learning ("minor functionality fragment"), manifesting in the transition of quantitative changes of learning and cognitive abilities of students into qualitative transformation. In this regard, the didactic cycle ap-

pears as an aggregate of phases of education process, the total of learning micro-results [13].

Let us consider the combination of uniqueness of content of professional pedagogical education within bachelor's and master's programmes in natural sciences and commonality of procedural aspect of cycles. A didactic cycle possesses all the basic characteristics of a pedagogic process:

1. Purposefulness presupposing orientation of a didactic cycle and submission of all pedagogic conditions of its realisation at achievement of final education result by students – that is, professional pedagogical competence.
2. Internal system integrity which is achieved by interrelated combination of structural elements of a didactic cycle: purpose, content, procedural, technological and diagnostic elements (V.S. Bezrukov).
3. Dynamism manifesting in space-temporal evolvement of a didactic cycle of professional pedagogical education within bachelor's and master's programmes in natural sciences with constant change on internal status according to phase logic. Each phase is like a “cycle in miniature” with determination of goals, grasping of modular content, solution of educational and training tasks of a certain type and compulsory reflection and diagnostics of a micro-result.
4. Iterativity (repetition) found, to a wide extent, in constant reproduction of a didactic cycle at the level of bachelor's and master's programmes of the professional pedagogical education; in manifestation of phases of a didactic cycle on a scale of a learning module, a course of study or a lesson with continuous testing, analysis and adjustment of obtained micro-results. Iterativity of a didactic cycle of formation of professional pedagogical competence in students allows to test, analyse and specify the education process at higher school. Iterativity of the process of formation of professional pedagogical competences is manifested also in multiple repetition of information by students during solution of educational and training pedagogic tasks.
5. Controllability of educational and training activity, commitment to results increasing efficiency of the process of formation of professional pedagogical competences in students due to more clear organisation based on continuous reflection and diagnostics of micro-results in each phase of the didactic cycle.

Draft design of system periodicity model of professional pedagogical education within bachelor's and master's programmes in natural sciences included development of preliminary design decision for the whole system and for certain cycles. In the result a draft project was created, uniting principal constructional decisions allowing to have a general idea about technological and organisational aspects of professional pedagogical education of students of natural sciences departments.

We would like to underline hierarchical character of the system model professional pedagogical education within bachelor's and master's programmes in natural sciences and different scale of manifestation of periodicity within it. Hierarchy is realised through macro-, meso- and micro-didactic cycles within the structure of a system model. It is worth to be noted that attributes of each didactic cycle within a sys-

tem model are represented by goals (especially for education activity within subject-subject dialogic interaction), types of tasks for solution and performance.

Macro-didactic cycles within a system model are defined on the basis of multi-level organisation of higher pedagogical education and are established by the cycles "Bachelor's Degree" and "Master's Degree".

Bachelor's degree is a basic level aimed to give students a possibility of vast social and pedagogical practice, solution of current daily and algorithmic general pedagogic tasks and problems of teaching of sciences at school. It is characterised by combination of fundamental nature and applied focus, which presupposes integration of science and practice [14].

Master's degree is functionally oriented. It gives student an opportunity for further study of pedagogic problematics for innovative creative activity within a chosen professional field. Special feature of professional education within the Master's course is substantial level of independency, individualization and personal responsibility of student for the result [14]. The content of education does not have a uniform structure, it integrates two components: educational and scientific research. Both components are focused at achievement of high quality result which manifests in mastered professional competence in the sphere of teaching of sciences at schools.

Meso-didactic cycles within the system model of professional pedagogical education within bachelor's and master's programmes in natural sciences are represented by education modules and subjects comprising the cycles. They are focused at acquiring of necessary types of pedagogic activity and professional competences by students. The level of Bachelor's degree is represented by interconnected combination of general cultural, psychological and pedagogical, profession-oriented education modules. The level of Master's degree comprises academic and pedagogical, information and communication, management and methodical modules.

Micro-didactic cycles within the system model are equal to the level of learning session, fulfilment of project requirements by students, solutions of education and professional (quasi-professional) tasks imitating real conditions of business communication (case-study).

### **Phase Logic of the Didactic Cycle of Professional Pedagogical Education within Bachelor's and Master's Programmes in Natural Sciences**

Let us consider specificity of unified phases of the didactic cycle of professional pedagogical education within bachelor's and master's programmes in natural sciences: initiatives and perspectives, designing, implementation, assessment of results.

The phase of initiatives and perspectives is a starting one. It is a first step of the cycle, accompanied with inner motivation of student to professional pedagogical activity in the field of science studies. It is based on motivation, problematisation, goal-setting, communication, reflection. Motivation is a mechanism starting the cyclic

process of “entrance” of the student into the pedagogic profession, within which the student realises social and governmental significance of chosen professional field for sustainable growth. In the result the student forms an idea and realises the problem represented by contradictions between understanding of personal value of professional pedagogical activity and incompetence in this sphere. A “shift of a motive to the purpose” takes place, a student realises the perspective for achievement of professional pedagogical competence.

Manifestation of iterativity within the phase of initiatives and perspectives is associated with reflection. In the result of reflexive analysis, after the abovementioned phase a student can answer following questions: “I know, I am ready and I am able to explain: why I need higher pedagogic education in the field of natural sciences and what I need for achievement of the set goal”.

In the phase of designing the focus is shifted to informational, cognitive, practice-oriented, communicative and reflexive types of activity. Informational activity presupposes an ability of a student to independently do the search, analysis, interpretation, systematisation, critical evaluation of pedagogic information; to use obtained information for planning and realisation of his learning and professional activity depending on the purpose; readiness and ability to use informational and communicative technologies.

Cognitive activity presents the basis for professional pedagogical competence. Its sphere includes special theoretical and practical knowledge and skills needed for scientifically grounded solution of professional problems.

In the result of reflexive analysis of learning and professional activity at the phase of designing a student can answer a following question: “I know, I am ready and I am able to explain and show what I should do for solution of professionally-oriented pedagogical situation”.

The phase of implementation is associated with independent activity, initiative, responsibility of students, various communication, reflection. Specificity of learning and professional activity at the phase of implementation is manifested by high level of creativity, mental adaptivity of students upon acquiring of the content of professional education characterised by adherence to pluralism, imitating situations of real pedagogic activity (including during the teaching practicum at an educational institution). Practice-oriented, communicative and reflexive types of activity have the highest priority. Content of practice-oriented activity is connected with prediction of development of professional pedagogic situations during teaching of school subjects of natural sciences cycle.

Communicative activity is present during the whole cycle, however at the phase of implementation is holds a very important place. This type of activity presupposes

participation of students in interpersonal communication promoting development of significant personal and professional qualities.

The phase of assessment of results and reflection is accompanied by monitoring research, complex iterative testing, drawing up of expert report by the supervisors, carrying out of reflection by students in order to define efficiency of professional activity in the course of current cycle.

## **Conclusion**

Results of assessment of the system periodicity model of professional pedagogical education within bachelor's and master's programmes in natural sciences let us state efficacy of the chosen methodology of macro-development within the system of Russian higher education for provision of optimal ways of efficient pedagogic interaction.

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