

PEDAGOGY

System modeling criteria of the optimization process of professional training of future psychologists at higher educational institutions**M. Yevtukh^{1*}, E. Luzik²**¹ Higher Education Department, National Academy of Pedagogical Sciences of Ukraine, Kyiv, Ukraine² Professional Pedagogy and Psychology department, National Aviation University, Ukraine, Kyiv, Ukraine

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Abstract. The article is devoted to the problem of the optimization process of training future psychologists at higher educational institutions by means of system modelling criteria of the educational process: didactic invariant elements of learning activities. The article is devoted to the problem of the optimization process of training future psychologists at higher educational institutions by means of applying formulated criteria of system modelling of the educational process, that is didactic invariant elements of learning activities. The solution of this problem is due to a change of higher professional education system paradigm in Ukraine, which, being defined as a transition from *a process approach* for specialists' professional training organization to a resultative (effective) one, promoted the formation of a new vision of educational results, considered as the basis of this training. Hence, the conditions associated with the optimization of the elements of the psychologists' didactic training at higher educational institutions and quality criteria of this training are considered as dominant.

Keywords: *system modelling, competence approach, didactic invariants, optimization of professional training*

Introduction. The growth of information flows in information-and-educational environment, social-and-economic and political transformations at the present stage of the country's development, the introduction of competency-credit approach at higher education institutions (HEIs) have contributed to the formulation of fundamentally new problems in the educational system as a whole, considering it a coherent unity of training, education and personal development; result of general culture and education, the product of forming the image of the outside world into the inner world of the individual as a professional subjectivity and immediately in the system of higher education, as it plays leading role in shaping the scientific and intellectual potential of the country.

The paradigm shift of the system of professional higher education in Ukraine, according to the European Commission project "Setting educational structures in Europe" defined the transition from a process approach towards professional training to the effective one, contributed to the formation of a new approach to educational results, which are taken as a basis for this training. The essence of effective approach lies in the fact that educational results of training should be formed only in terms of competencies, acquired by the education competitors, while competence data form the basis of qualifications (competencies) that are awarded to graduates by education employers. In addition, the implementation of the effective approach to the system of professional education of Ukraine contributed to the fact, that the priority social-and-economic vectors of higher education, which are defined by the state regulatory documents, determined the strategic goal, the main idea of which is to ensure that country's experts are adapted to changing conditions of labour market and can competently, independently and responsibly perform multi-tasks; are ready to continuous professional growth, social and professional mobility. As a result, to the fore comes not only the productive knowledge gained from changing, information contradictory environment in which the educational system as a whole is located, but also the

subjects of the educational process and the ability to operate them, to act dynamically and make optimal decisions, enabling the future specialist effectively orientate in today's open and dynamic information space [4, 5].

Thus, the objectives of the educational system and its results serve as system-forming factors, according to which psychosocial components of educational activities, forming most important tasks of modern higher professional education of Ukraine, namely: identification of competencies (results of the education) qualification level (competence); changes in the structure and content of training, development of innovative technologies and search for valid and reliable means of diagnosing training results.

In this respect we define dominant requirements, related to the optimality conditions of didactic elements of professional training of psychologists at higher educational institutions and criteria (framework basis) of training quality, while by optimality conditions we mean quantitative and qualitative correlation between the didactic components of educational activities that allow the subjects of this activity to carry out the process of converting obtained knowledge and skills into personal mental capacities (experience, traits, targets, ability) provided that the productive knowledge transforms into orientation and conviction of the individual, and integrated and intellectual skills transform to ingenuity and professional abilities.

In the encyclopaedia, published by International Society on Complex Systems Research in 1997, there were named a number of prominent scientists who made outstanding contribution to the development of certain aspects of complex (non-linear) thinking that promotes the development of future specialists' creative abilities. Among them – Gregory Bateson, Stafford Beer, Francisco Varela and Humberto Maturana, Norbert Wiener, Ilya Prigogine, Claude Shannon and others [1, 2, 3].

The object of the research is criteria of system modelling of professional training process of future psychologists at higher education institutions.

The goal of the research is to define conditions of optimal elements of professional training process of future psychologists at higher education institutions and criteria (system-forming basis) of the quality of such training.

The research tasks are:

- 1) to define system-forming factors of the quality of future psychologists training at higher education institutions in Ukraine;
- 2) to form the structure and the content of professional training of future psychologists based on the competence approach and to elaborate valid and reliable tools of diagnosing the results of professional training of future psychologists.

Methodology of research. The methodology of the present research lies in the realization of new conditions used in professional training of future psychologists at higher education institutions, which is possible due to the renewal of the structure and content of professional education in the integral professional outer information space, implementation of the information-and-synergetic system of pedagogical technologies, directed at the realization of the tasks of the educational process of a specialist who is capable to work effectively in the dynamically-changing environment.

Results of research. It is known that the traditional system of training psychologists at higher educational institutions is mainly focused on the discipline-based training of the graduate, while activity-and-role components (knowledge, abilities, skills) play the key role, but they represent only one component of the specialist's professional competence; namely, the renewal (broadening and deepening) of the content of future psychologists' professional competence takes place, while the success of further professional development depends on the level of the individual and professional self. That is why, according to some researchers, the subjective (personal) characteristics serve as the system-forming conditions (criteria), of future specialist's transition from one educational level to another, as they are responsible for the successful updating of professional knowledge and skills, providing harmonious professional development of the individual implementing personal learning trajectories occurring only in flexible, adaptive educational systems which expect professionals to have the ability of self-education and self-development, rapid professional reorientation, further training. The development of such personal qualities of future psychologists creates integrated opportunities for implementation of advanced learning through autonomy, self-awareness, self-control, leading to effective learning throughout life.

Thus, the implementation of new requirements towards future psychologists' training at universities is possible under many conditions of system-and-personal approach, but among them the priority is given to the update of the structure and content of professional education under the conditions of integrated professional external information space; implementation of information-and-synergy system of pedagogical technologies focused on the implementation of the educational process tasks of such a specialist who is able to work effectively in a rapidly-changing environment [6, 7, 8].

Due to the orientation of educational strategies of higher education in Ukraine on the personal development with the transfer of emphasis on the results of education,

the role of assessment of learning results in shaping the professional subjectivity of the future applied psychologist becomes crucial. That is why the following criteria of the process of future psychologists' training optimization at universities are considered:

- goal (objectives) of training, which is (are) interdependent and interconnected with the structure and the content of training;
- results obtained in the learning process, i.e. formation of professional subjectivity of the specialist;
- «efficiency» of the learning process, which links learning results with the objectives formulated at the beginning of training psychologists.

Based on the fact that any activity (including training) begins with the realization of the objective goal, and taking into account the multivectorism of the future professional activity of the psychologist, we will consider the goal as the first criterion of forming the professional subjectivity of a future psychologist as space-time vector, components of which, in general, are the subject-specific and general cognitive and pedagogical goals. On the other hand, the goal of training a professional psychologist at the university, based on the provisions of the basic conceptual competence approach, can be represented as a vector, that is the function of mutually interdependent and interconnected components and competencies $\vec{C}_1, \vec{C}_2, \dots, \vec{C}_n$, which, according to the regulations of psychologists' professional training, should be mastered by a specialist, that is:

$$\vec{O} = \vec{O}(\vec{C}_1, \vec{C}_2, \dots, \vec{C}_n), \quad (1)$$

where: \vec{O} – objectives of training, \vec{C}_i – competencies.

For effective implementation of the defined objectives of training future psychologists it is necessary to choose a mechanism of goals correlation with real results of training as a set of mastered by future psychologists productive knowledge, integrated skills and abilities and formed professionally important qualities.

In our opinion, the solution of this issue lies in the plane of system-and-personal didactic modelling, while by this term we mean the system of goal-conditioned actions, which can safely and validly provide adequate learning of modelled properties, connections and relations of information-and-dynamic cognitive and reformative objects of natural and socio-and-cultural dimension, in which the mental activity of the individual student serves as the subject.

Based on the concept of competence-and-concentric integrity of professional subjectivity of the future specialist in this sphere, taking into account regulations (GOST, Educational qualifications framework, Educational and professional programs), which define a set of professionally-oriented competencies, algorithm of system modelling of the educational process of future psychologists' training and concentricity of the development of such a specialist in the context of innovation management paradigm includes three main components that make up the core of man-socio-psycho-pedagogical nature of training, namely professionally-oriented, profession-forming and practical professional-reflexive-and-evaluative, each of which includes a number of stages. Thus, practical (reflexive-and-evaluative) stage, the main purpose of which is the update of applying the productive knowledge, integrated skills and abili-

ties; formation of mental capacities in the process of future quasi-practical professional activity of a future psychologist, including the following components:

> diagnosis and evaluation of practical readiness of a future psychologist to the professional activity;

> implementation of an integral, information-and-activity, personal components of professional subjectivity of a psychologist in accordance with international educational standards (modular organization of the learning process with interdisciplinary coordination of integrative courses);

> formation of integrated competencies of the psychologist's personality (self-development and career advancement, competitiveness on the market of educational services, high level of professional competence, co-creation opportunities with colleagues, strategic and practical thinking);

> willingness to form individual-and-reflexive market psychological and pedagogical technologies of self-creation in an integrated dynamic-and-synergetic environment, acceleration and enrichment strategies,

proves that, in this spiral-shaped process of learning, transition of a future psychologist to every new educational level will be implemented by means of the optimal-and-individual didactic trajectory.

In the capacity of the second criterion of professional subjectivity of future psychologist's formation we consider professional training result as an increase of the experience gained by the student in the process of created by us system modeling (by means of an algorithm) of the educational process of optimizing professional training of future psychologists at universities, namely, by means of competencies, which psychologists have to construct, i.e.:

$$R = \sum_{k=1}^n (C_1, C_2, \dots, C_n), \quad (2)$$

where: R – result, C_i – competencies.

For the introduction of the third criterion of forming the professional subjectivity, that is for "efficiency" of the process of optimizing professional training of future psychologists at universities, which links learning results with object-tives of training, reflected in the relevant regulations (GOST, Educational qualifications framework, Educational and professional programs), we use space-and-temporal dynamic model of educational standards, according to which the result of the educational process is related to its objectives and content (knowledge, abilities, skills) with the help of the ratio [9, 10]

$$R = (\vec{O} \cdot \overrightarrow{Con}), \quad (2a)$$

in which \overrightarrow{Con} is the vector-function of the educational content that includes didactic learning environment components (knowledge, abilities, skills) of professional training of future psychologists as a multi-vector component of the educational process. Draw. 1.

It is known that in the organizational-and-activity structure of the educational activities the result is considered as a consolidated system of integrated by the student abilities, skills, productive knowledge and formed professionally important qualities. At the same time a question arises, which is of particular interest to employers, namely whether it is possible, based on defined objectives (competencies) to predict in advance and prove didactically

the result of learning activities (formation of appropriate competencies)?

To get an answer to this question we use didactic invariants, meaning by the didactic invariant of the educational level an element of learning activities, which does not change as a result of altering research methods of learning. Based on this definition, in the capacity of the first didactic invariant we select the goal of professional training of psychologists as a vector, a function of interdependent and interconnected components of competencies that meet professional subjectivity of a future psychologist, i.e.

$$\vec{D}_1(I) = \vec{O}(\vec{C}_1, \vec{C}_2, \dots, \vec{C}_n) \quad (3).$$

The result of learning activities will serve as the second didactic invariant

$$\vec{D}_2(I) = R(C_1, C_2, \dots, C_n), \quad (4)$$

which is connected with the goal of professional training of future psychologists and with the corresponding content of this training

$$\overrightarrow{Con} = \overrightarrow{Con}(\overrightarrow{Con}_{gc}; \overrightarrow{Con}_{ss}; \overrightarrow{Con}_{ek}), \quad (5)$$

in which $\overrightarrow{Con}_{gc}$, $\overrightarrow{Con}_{ss}$, $\overrightarrow{Con}_{ek}$ are interdisciplinary vectors of general cognitive, subject-and-specific and educational knowledge, presented by the ratio

$$\vec{D}_2(I) = R(C_1, C_2, \dots, C_n) = (\vec{O} \cdot \overrightarrow{Con}) = W \cdot P \cdot \cos \alpha \quad (6)$$

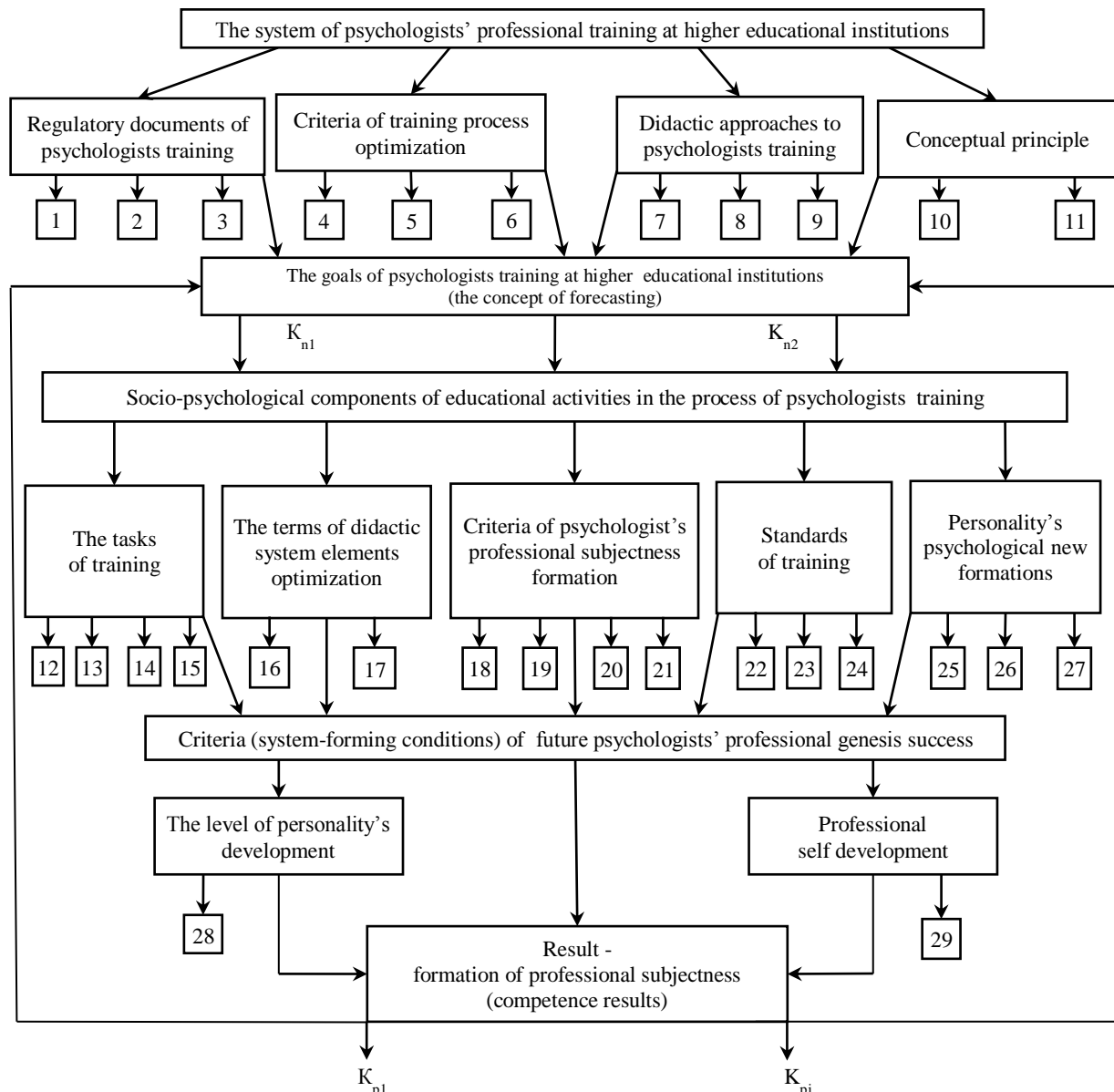
Let's demonstrate the last ratio.

Thus, if the accordance of formulas (1) and (3) is obvious, we will try to establish links between formula (4) and (6). In terms of defining work as a physical value, formula (6) is the result of educational process, performed by the subjects of the learning process (those who teach and those who learn) to transform imbedded in the learning process information into knowledge, abilities, skills, i.e. mental capacities of the student (his competence), in accordance with the formulated and reflected in regulatory documents objectives of education (competencies).

Specifications for models:

1. State standards of psychologists training at higher educational institutions of Ukraine.
2. Qualifying characteristics of psychologists training
3. Educational and professional training of psychologists.
4. The goals of the educational process: subject-specific, general cognitive, educative.
5. The result of training – formation of future psychologist's professional subjectness as an integrated set of professional-oriented, professional-forming and professional-practical (reflexive-evaluated) training.
6. "Coefficient of efficiency" of future psychologist's professional subjectness formation.
7. System-personal approach.
8. Synergetic approach.
9. Action-oriented approach.
10. The competency-concentric integrity concept of specialist's professional subjectness.
11. Principles of educational process management at higher educational institutions (overcoming linear thinking, complementarity, openness and so on).
12. Identification of competencies (training results) with qualification level (competences).

- 13. Formation of education structure and content.
- 14. Development of innovative technologies.
- 15. Development of valid and reliable means of training diagnostics.
- 16. D1. (I) - the goal of psychologist’s professional training.
- 17. D2 (I) - the result of training activities.
- 18. The content of future psychologists training (formula (5)).
- 19. The purpose of future psychologists training (formula (3)).
- 20. The result of training(formula (6)).
- 21. “Coefficient of efficiency” of optimization process of future psychologists training at universities (formula (7)).
- 22. Knowledge Vector: general-cognitive, subject-specific and pedagogical (K).
- 23. Vector of integrated skills (S).
- 24. Vector of intellectual skills (S).
- 25. Experience.
- 26. Character features (independence, responsibility).
- 27. Abilities.
- 28. The capacity for professional reorientation; advanced training.
- 29. The capacity for self education and self development.



Drawing 1. Model of integration-activity system of psychologists’s professional training at higher educational institutions

The essence of the graph $P = \frac{2m}{n}$, where m – number of edges, n – number of vertices (in the first case $m = 26$, $n = 16$), is equal to 3.25, which confirm the compliance with didactic continuity and continuity of knowledge laws.

Based on the fact that the issue of optimality of the learning process is proved in works [9, 10] in accordance

with which the second didactic invariant should differ from $0 \cdot D_2(I)$ is a prerequisite of spiral-based learning process (congruence of dynamic principles of continuity of succession), in which the student’s transition to a new educational level will be accomplished by applying the didactic spiral by the personal-and-optimal trajectory.

However, it should be noted that if the vector of the content of education (\overrightarrow{Con}) is located in the information-and-educational environment of training arbitrarily and does not coincide with the direction of objectives vectors (\vec{O}) (lack of appropriateness of disciplines content with the goals and objectives of professional training of a psychologist), the educational process will be realized by the didactic spiral provided that the goals, defined by the educational level (the Educational qualifications framework and Educational and professional programs) are achieved with the defined level of professional subjectivity of a student. The efficiency of the learning process that describes this relationship and selected by us as the third criterion of forming the professional subjectivity of future psychologist, is defined by the ratio

$$d = \frac{con}{o} \quad (7),$$

thereby confirming the difference ("gap") between the government order (competencies) which should be mastered by a future psychologist and competences (knowledge, abilities, skills, mental capacities) of a future specialist, a psychologist, in the process of student-centered learning activities.

Let's consider three possible options of success of a future psychologist's professional training process.

1. If the vector of the content of education (Con) is in the plane perpendicular to the vector of goals (O) of the educational level, i.e. the content of educational and professional programs of corresponding disciplines does not go in line with the goals of training, reflected in the regulatory documents of this level, then, based on the ratio (6), the second didactic invariant $\vec{D}_2(I)$ will be equal to zero ($\cos 90^\circ=0$). This means that the student does not perform successful educational activities of converting the received in the learning process information into productive knowledge and integrated skills in accordance with the set objectives of disciplines, and therefore does not form the necessary professionally important qualities. As a result, the necessary and sufficient conditions for the formation of the components of professional competence will not be formed.

At the same time, the level of general cognitive knowledge, possessed by the student, is sufficient to expand its circulation (abilities), whereby, on completing the training level (course, year), the level of success of the educational process will not promote the transfer of a student to a higher education-and-professional level.

2. If the vector of the content of education (\overrightarrow{Con}) is located in the same plane as vector of goals (\vec{O}) and coincides with it in the direction (and the content of the educational and professional programs goes in line with the goals of training), the student, having a sufficient level of knowledge, abilities, skills and a high positive internal motivation is able to effectively carry out training activities on the interiorization of productive knowledge into integrated abilities and intellectual skills, thus forming corresponding components of professional subjectivity of a future professional. As a result, formed by the student mental capacities allow on completing the given educational level to make a successful transition to the next level with the help of didactic spiral by optimal curve and the learning process by intellectual and professional development of the individual is harmoniously creative.

3. If the vector of the content of education (\overrightarrow{Con}) is located in the same plane, but arbitrary with respect to the objectives of the vector (\vec{O}), the success of the learning process by didactic spiral will depend on the conditions when the transition to each next level will be implemented only after reaching by a student of the defined by the certain education level professional and educational objectives with specified levels of education and under the condition that relevant professionally important qualities of character are formed. The factor, that characterizes this relationship, corresponds to the ratio (7).

Conclusions

1. Implementation of system modeling process of the optimization of professional training of future psychologists at universities is possible due to the introduction into the educational process of training criteria (didactic invariants) $\vec{D}_1(I) = \vec{O}$, $\vec{D}_2(I) = R$, which interdepend and interconnect the goals of education $\vec{D}_1(I)$ (competencies) and the result of education $\vec{D}_2(I)$ (competences).

2. The difference of the second didactic invariant from zero $\vec{D}_2(I) \neq 0$ is a prerequisite of spiral-shaped (harmonious) process of forming the professional subjectivity of a future psychologist.

3. Student's activities directed to the interiorization of productive knowledge and intellectual skills into mental capacities are most effective when the "field of knowledge" and "field of goals" of professional training of a psychologist coincide. In this case, the learning process will represent the spiral-shaped harmonious curve, and intellectual and professional development of the individual as a creative one.

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