

PEDAGOGICAL SCIENCE EDUCATION MANEGMENT IN TEACHING SCIENCE OF PEDAGOGICAL SCIENCES

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ABSTRACT

The paper deals with the existing approaches to the management of educational systems and their compliance with new educational standards. Methodology of coordinated management of multilevel system of specialists training, aimed at mastering professional competencies and meeting the requirements of the modern labor market is described. The mechanisms of methodology implementation in the system of software developer's training are shown. An example of the application of the developed methodology in organizing the management of a specialist's training system in the sphere of software development is given.

Keywords: competence paradigm, multilevel hierarchical system, coordinated management, knowledge space, game educational technologies

The explosive development of information technologies has led to qualitative changes in all areas of social life and activity, which has led to the formation of an information society based on the consumption and reproduction of knowledge. The ongoing changes in society as a whole require systemic changes, primarily in the educational sphere. The key condition for the training of competitive specialists was to ensure their competence, which allows them to carry out professional activities in the conditions of continuous updating of professional knowledge, the emergence of new professional tasks and their constant complication [1,10].

To organize a new system of training specialists, it is necessary to develop new forms of communication between knowledge, skills, on the one hand, and competencies, on the other hand. The establishment of such a connection is possible with a change in the management of the system of training specialists, adequate to the goals set. Such a management organization requires the introduction of new models of system management based on information technologies (IT) into the educational process, which provide the ability to manage the activities of each subject of the system in a dynamically developing information-conceptual space of professional knowledge [1,10-15].

Setting the goal and method of research

The aim of the work is to increase the effectiveness of training software developers by organizing the management of the system of training specialists, which allows them to systematically master professional competencies that meet modern requirements.

When developing a learning organization model, methods of the theory of management of organizational systems, general theory of modeling were used; when developing a model of the learning process, methods of general systems theory, system analysis, the mathematical apparatus of general theory of lattices, set theory, graph theory were used; to analyze the effectiveness of the proposed solutions, methods of mathematical statistics [2-5].

Analysis of approaches to the management of educational systems

To organize the educational process on the basis of the material and technical base of the educational institution, a system for training specialists in various industries is created and maintained. The system of training specialists in a higher educational institution (university) includes the teaching staff (TS) and groups of students directly involved in the educational process; and also the administration, personnel and logistical, financial, organizational, methodological and information resources used to support the organization of the educational process.

The presence in the university specialist training system of such organizational structures as teaching staff and groups of students determines the belonging of the specialist training system to the class of social systems [9-12].

The functioning of the training system requires continuous financial support. Financial investments in such systems create the intellectual capital of society, and thus are the society's investments in its future development. Ultimately, as a result of the professional activities of specialists trained in educational systems, surplus value is created and the economic potential of society as a whole increases. In this interpretation, the system of training specialists as a system of social production and consumption of material goods belongs to the class of economic systems.

The goal of managing the system of training specialists is the effective use of social and economic resources invested by society in the system for training specialists with a level of professional competence that meets the existing requirements of the industry and its development trends. The control subsystem in the system of training specialists is represented by trainees. The specifics of the management of educational systems is that students are directly involved in the learning process and play a key role in it, because the learning process requires the work of the trainees themselves to master knowledge and develop professional skills.

The composition of the components, the specifics of connections, the socio-economic nature of the management goal and the active influence of students as a controlled subsystem on the management process determines the belonging of the system of training specialists to the class of socio-economic systems (Figure 1.1).

Two types of management are implemented in the specialist training system: administrative management and management of the learning process. Administrative management provides organizational, material and financial support for the learning process. Management of the learning process establishes ways for teachers (teacher) to organize the interaction of students (trainee) with educational resources (training course), which allow achieving learning goals and determining the effectiveness of managing the training system as a whole.

Teaching methods are usually understood as ways of joint work of the teacher and trainees. With regard to educational structures, teaching methods are divided into passive and active [6, 9].

Passive (traditional) teaching methods include lectures, seminars, educational videos, and others. These methods are predominant in the transfer and consolidation of knowledge. Traditional teaching methods have a number of disadvantages: they do not allow to take into account different levels of knowledge, do not imply feedback that demonstrates the degree of assimilation of the material. With active teaching methods, much attention is paid to the practical basis of the knowledge, skills and abilities transferred to students. Currently, trainings, programmed training are widespread.

Studies in the field of management of the system of training specialists [7,8] show that a targeted system-wide approach is needed to organize effective management. The possibility of achieving the goal of management is due to the choice of a learning management system, the implementation of the system components and the organization of their relationships. The organization of management of the educational system is inseparably connected with the modeling of various aspects of the educational process, both for analysis, studying the properties of the implemented educational process, and for organizing the management process based on the proposed models.

Cognitive, situational, resource models, system dynamics models, network and neural network models are used to control the quality of the educational process [10]. Such models are designed to select the organization of the educational process, which is optimal in terms of the quality of education in general. The mechanisms of organization of the educational process in such models are not considered.

For the analysis and planning of the educational process, in most cases, algebraic or differential equations of various types are used [4-6]. Continuum models allow you to set the quantitative characteristics of the process and display the process itself with varying degrees of adequacy. However, regardless of the mathematical apparatus used, the continuum models of the learning process for the most part are not related to the structural and logical features of the studied areas of knowledge and do not establish ways to organize the process of their development.

In most cases, the educational process is modeled as a recurrent sequence of student "transitions" between fragments of educational resources, represented by trajectories on graphs of various types. Discrete models for managing the educational process establish a sequential-parallel order for mastering disciplines regulated by the corresponding educational program (EP), the so-called. educational trajectories. To build discrete models [6], Petri nets, Markov chains, finite automata, Bayes nets, etc. are used.

Trajectory management methods are focused on the educational standards of the 2nd generation, according to which the results of mastering the EP are evaluated as "gaining knowledge, skills and abilities" within individual disciplines (the ZUN paradigm).

In the context of new educational standards, the requirements for the results of mastering the EP are formulated in terms of professional and general cultural competencies that determine the ability to carry out professional activities, which necessitates structural changes in the organization of the system of training specialists and the development of qualitatively new models and methods of managing the system that meet the new requirements [5].

The key criterion for the quality of training of specialists is compliance with the requirements of the labor market. Qualitative changes in the structure of modern society have led to qualitative changes in the structure of the labor market.

On the one hand, the modern labor market requires specialists of different levels of competence. On the other hand, the strong structural coherence of labor market fragments requires continuity and development of competencies at all levels of training. In the new educational standards, this is reflected

in the requirements for the level organization of the training system and its specialization. Ensuring the achievability of the goal of managing the system of training specialists in such a context necessitates the integration of educational resources compared to educational programs of various levels into a single information and conceptual space of professional knowledge and harmonization of goals, resources and management methods at different levels of the system.

- The concept of system management has been developed, which implements the formulated requirements. The specialist training system is considered as a multi-level hierarchical system of relatively independent, interacting subsystems that determine the training of specialists of the appropriate level of competence. System management is considered as the organization of the activities of subjects of management (MS) and objects of management (OC), which ensures the continuity and development of the competencies of the educational institution in the hierarchy of educational programs at different levels. Goals, resources and management results are compared to each level of training. Goals of management have both SU and OC, and these goals do not necessarily coincide. From the point of view of SU, the goal of management is to master the system of competencies determined by the appropriate level of training. To achieve the goal, the SU organizes the activities of the educational institution that have a measurable result. The result is the goal of the OS activity. Various management tools can be used to organize the activities of the educational institution. Achieving the goal of system management is ensured by coordinating the goals, resources and results of management at all levels of the system.

- The system management concept is based on the following principles [1,5,9]:
- the hierarchy of labor market needs determines the hierarchy of goals for managing the system;
- the hierarchy of goals determines the hierarchy of competencies;
- the hierarchy of competencies determines the hierarchy of system levels;
- a set of ORs compared with EPs of all levels is combined into a single information-conceptual space, represented by a knowledge space;
- management of the system is considered as the organization of the activities of the educational institution for the development of the knowledge space;
- the interaction of the OC with the knowledge space determines the dynamics of the state of the OC in this space;
- Achieving the goal of management is to achieve the status of the MA that satisfies the required level of competence, determined by the relevant EP;
- assessment of the achievement of the goal is of a qualitative nature, due to the non-numerical nature of competencies.

Model of the specialist training system

The organization of management of training of specialists is carried out according to educational programs (EP), which determine the goals and results of training and regulate the composition and structure of educational resources (ER), the development of which is necessary to achieve the goals. Accordingly, the model of the specialist training system can be represented by a tuple:

$$SSP = \langle KS, Y, \Phi, X, D, R, P, F \rangle, \quad (1)$$

Where KS – the space of professional knowledge defined by the OP;

At the same time, each level of the system is determined by the goals of training, which are represented by a set of competencies to be mastered. The competencies mastered at the appropriate level suggest that such specialists are in demand in the labor market.

Management at each level is considered as management of the process of mastering the OU of the corresponding subspace of knowledge KSk. The purpose of control X is defined as the achievement of the state defined by the level. Thus, the level models determine the category of models, each of which can be represented by a tuple of the form (1). The relationship between different models is defined as a categorical functor or morphism of models.

The dynamics of the state of a multilevel system is defined as [2,7,10]:

$$\begin{aligned}\varphi_{k+1} &= P(\varphi_k, y_{k+1}) \\ y_{k+1} &= d_k(\varphi_k, r_k) \\ d_{k+1} &= F(\varphi_k, y_{k+1})\end{aligned}$$

where k is the level of the system, $\varphi_k \in F$ -respectively the state of the CO, $r_k \in R$ are the resources, $y_k \in Y$ are the results, $d_k \in D$ are the actions of the CO associated with the k -th level.

Presentation of the system of training specialists as a multi-level hierarchical system ensures the relative independence of goals at each level of the system. To ensure the achievability of the goals of managing the system as a whole, a management method has been developed based on the coordination of goals, resources and management results at all levels of the system.

The algorithm of the method includes the following steps:

each k -th level of the system is associated with a set of control goals X_k ;

goals X_k determined by SU are interpreted as the results of the actions of the MA:

$X_k \rightarrow R_k$;

as resources R_{k-1} , the results of the actions of the OS in the process of mastering the EP of the previous level are used: $Y_k \rightarrow R_{k-1}$.

Thus, the system control function has the form:

$U = [VC; HC]$,

where $VC: Y_k \rightarrow R_{k-1}$ is a vertical alignment or morphism of results into a set of resources; $HC: X_k \rightarrow R_k$ – horizontal alignment or morphism of goals into a set of results.

The specifics of the training of software developers (SW) determines the requirements for the organization of system management.

The bandwidth is a function of the student's intellectual state and his a priori knowledge, emotional state and emotional reaction, and changes in the learning process depending on the amount of information presented $I(t)$ and perceived $J(t)$ information, the way $I(t)$ is represented, the degree of training and others. factors [7].

The initial value λ_{0i} of the i -th student can be expressed by regression equations from the initial parameters of the cognitive and emotional states of the i -th agent based on the correlation and regression analysis of experimental data in the form

where p_{ij} are linear multiple regression coefficients; c_{ij} is the j -th parameter of the i -th student's cognitive state; e_{ik} is the k -th parameter of the i -th student's emotional state.

Assuming that λ_i does not change in the process of perceiving current information and depends mainly on the level of a priori knowledge and the degree of training, it is possible to evaluate the effectiveness

of the process of accumulating knowledge by the i -th student by the coefficient R_i as the ratio of the information perceived by him $J_i(t) = \lambda_i \cdot t$ to the presented $I(t)$ in the form

$$R_i = \frac{\lambda_i \cdot t}{I(t)} = \frac{1}{I(t)} (p_{i0} + \sum_{j=1}^n p_{ij} c_{ij} + \sum_{k=1}^m p_{ik} e_{ik}) \cdot t, \quad (4)$$

$i=1, \dots, N.$

With known or given estimates of the coordinates of the emotional state vector in the 15-dimensional emotional space, after the next event, the area of the most intense emotional reaction is determined, which determines the further actions of the agent [7-9].

The coefficient of psychological tension of an agent is determined by the ratio of the absolute number of antagonistic connections to the total number of interacting agents.

Based on the simulation results, it can be concluded that students should focus on obtaining knowledge given by teachers, while it is necessary to devote enough time to self-training. As a control action, one can single out the control of the acquired knowledge as the most effective [7].

As a result of the introduction of the developed methodology in the management of the system of training software developers, students of all levels of training have mastered almost all the competencies required in the framework of the relevant curricula.

Conclusion

The overall result of the work is a scientifically based solution to the problem of creating methodological foundations for organizing the management of a competence-oriented system of training specialists in a higher educational institution as a socio-economic system. When solving this problem, the following results were obtained [1-3,6,11]:

- ▣ the system of training specialists in a higher educational institution was studied, the features of the system of training software developers were identified and the requirements for organizing the management of the system, taking into account the specifics of training programs for software developers, and corresponding to the competence-based approach, were determined;
- ▣ a two-loop method for managing the software developers training system is proposed and mechanisms for implementing the system management function are developed;
- ▣ the concept of organization of the learning process, which implements the competence-based approach, as a controlled wave process of mastering the space of knowledge, in which the actions of the student reflect the non-linear structure of the knowledge space and are determined by the properties of this space, is proposed;
- ▣ it is shown that the proposed model of the learning process reflects the synergy of the process of mastering knowledge and implements the principle of unity of purpose and method, i.e. achieving the goal of learning by controlling the movement of the wave of knowledge acquisition in the knowledge space;
- ▣ a model for organizing training for software developers is proposed, which implements the developed model of the learning process and allows to systematically master the knowledge spaces of training courses and thus achieve the learning goals as a formed set of competencies of a software developer;
- ▣ a model of a training course based on an algebraic lattice has been developed, which allows reflecting the system properties of the knowledge space of the training course and constructing a calculus for the process of mastering this space;

The proposed methodology for managing a competence-oriented system of training specialists required not so much a change in curricula, work programs, retraining of teaching staff, but a change in the management system within the existing system. The ability to use educational resources created directly by students and directly in the learning process allows students to reveal their competence potential and orient the teaching staff to meet the current requirements of society in the form of the needs of employers.

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