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CYBERNETIC APPROACH IN PROFESSIONAL TRAINING OF AIR TRAFFIC CONTROLLERS

The article deals with the problem of air traffic controllers' training individualization, and in order to solve this problem the cybernetic approach to training of such kind of specialists has been used. It has been revealed that one of the most important tasks in initial training of air traffic controllers is the individualization of future air traffic controllers' training and the use of feedback for the organization and implementation of corrective measures to eliminate the deficiencies found during the simulator phase of training and errors in the formation of professional skills and abilities of cadets whose gaps in pre-flight training have not been clarified. The content and essence of the cybernetic interpretation of didactic processes, the analysis of the structure and content of training from the standpoint of cybernetics, the spread of the principles of cybernetics and the theory of information at different levels of training have been carried out. The main tasks of cybernetic pedagogy such as analysis of the pedagogical system in terms of control links and information flows, which control and controlled subsystems exchange, optimization of the training process, finding such forms and methods of organizing the training process, in which the functioning of the education system would be most effective, that is, at the lowest cost, would bring the maximum benefit, practical use of electronic devices and automated training systems for controlling the training and testing process; programmable training have been investigated. Some deficiencies have been identified from the part of the control and controlled component of the air traffic controllers' training, namely, the inadequate use of the results of systematic feedback, making it difficult for the teacher to obtain information on the quality of the step-by-step solving of training tasks, on typical disadvantages. The components of the training process such as targeting, stimulating-motivational, informative, operational-activity, control-regulating, evaluative-productive, which reflect the process of interaction between the teacher and the cadet from the point of view of the training purpose to the analysis of its results, have been revealed. The basic aspects of air traffic controllers' training on the basis of a cybernetic approach have been grounded. All aspects of air traffic controllers' professional training based on the cybernetic approach will allow the activities decomposition of both the teacher and the cadets in the course of the training lesson providing the simulator training correction.

Key words: air traffic controller, cybernetic approach, feedback, professional training, simulator training correction, components of the training process.

Formulation of the problem. One of the main factors of providing safety of flight is high professionalism of air specialists, which is largely dependent on the level of professional training. One of the most important tasks in conducting initial training is the individualization of future air traffic controllers' training. At the moment this task is not solved, for its solution it is necessary to use the results of feedback in the course of professional training. It is established that feedback

results are insufficiently used for organizing and carrying out corrective actions to eliminate drawbacks and errors in the formation of cadets' professional skills and abilities found during the simulator stage and gaps in pre-flight training are not revealed.

Analysis of recent research and publications. The content and essence of the cybernetic interpretation of didactic processes, the analysis of the structure and content of training from the standpoint of cybernetics, the spread of the principles of cybernetics and the theory of information at different levels of training is researched in the works of scientists such as L. B. Itelson, S. I. Arhangelskiy, V. P. Bepalko, V. E. Firstov, L. B. Itelson, E. I. Mashbits, I. V. Robert, N. F. Talyizina, etc. The purposefulness and informational nature of didactic processes determine the objective connection between cybernetics and pedagogy. This connection is realized on the basis of the theory of information and cybernetics (K. Shannon, N. Winner, 1948), relying on universal information principles of processes management of any nature including training processes. Training can be considered as the trainee's personality development regulation through the purposeful control of their activities and behavior [2].

From the point of view of the pedagogical science new direction – cybernetic pedagogy [3], the main tasks are:

1. Analysis of the pedagogical system in terms of control links and information flows, which control and controlled subsystems exchange.
2. Optimization of the training process, finding such forms and methods of organizing the training process, in which the functioning of the education system would be most effective, that is, at the lowest cost, would bring the maximum benefit.
3. Practical use of electronic devices and automated training systems for controlling the training and testing process; programmable training.

In general cybernetic control requires its using on the basis of the following principles [1]: indication of the control purpose; formulation of criteria for assessing the goal achievement; setting the output state of the controlled system; development of the influence program, which provides the main transitional system state, due to the controlled process specifics, the control purpose and the initial state of the system; accumulation and processing of information on the selected system parameters that characterizes the state of the system at each control point (feedback); making corrective influences on the results of processing information received with the help of feedback; implementation of corrective effects.

Within the cybernetic approach to teaching, N. F. Talyizina [5] distinguishes three types of correction of the existing system state:

- 1) response to the expected changes in the situation (in this case indirect signs of harmful effects are expected and, in accordance with their nature, the program is restructured);
- 2) response to changes in a situation that has already occurred, but has not had a negative impact on the planned system state yet (correction of the program is carried out in accordance with changed system state);
- 3) response to errors (here there is a deviation during the process under the influence of those or other harmful effects on it, and the correction is carried out in accordance with the nature of the deviations based on the errors analysis).

The purpose of the article is to identify the main provisions of the cybernetic approach and their adaptation to air traffic controllers' professional training in terms of the control and adjustment component implementation.

Presentation of the main material. According to the conceptual provisions of the cybernetic approach professional training is considered as a complex dynamic system that is controlled on the basis of direct (sending commands) and feedback between the control subsystem (teacher or curriculum) and a controlled subsystem (cadet).

At the same time, the functions of the control subsystem include: presentation of information, error correction, evaluation of the training activities results, stimulating the operation of a controlled subsystem providing feedback. All that, in turn, provides control influence. The main functions of a controlled subsystem are the information perception and processing, the

implementation of appropriate exercises, tasks, the implementation of corrective actions based on the analysis of feedback results, self-control and advancement in the educational trajectory. At the same time it is very important to ensure systematic feedback, which is the basis of quality control of the learning process. The presence of feedback is the basis of quality control of the training process. Feedback in training is interpreted as information coming to the trainee about the carried out training activities and this activity results [4]. The information about the state of the controlled system is transmitted through the feedback channel. Thus, favorable conditions for conducting control and corrective actions of the teacher and better assimilation of information for the cadet are created. Feedback is particularly significant in the implementation of a closed type of control, which involves continuous analysis and diagnosis of the main characteristics of training at each stage.

The main provisions of the cybernetic approach determine the functions of the teacher, taking into account the requirements of the general theory of management and for the training process they can be formulated as follows:

- 1) to determine the purpose of training;
- 2) to establish the initial state of the controlled process (training activities of cadets);
- 3) to determine the program of action which is provided for the main transitional stages of the training process;
- 4) to provide systematic feedback "teacher-cadet" and "cadet-teacher" in the training process;
- 5) to ensure the processing of feedback data and to produce a corrective impact on the training process on their basis and to implement it.

To ensure the integrity of the control system, it is necessary to implement it in three stages:

- 1) to receive the initial information from all cadets about their actual knowledge, skills and abilities (to find the level of achievements);
- 2) to compare the output data (teacher or automated training system) with the reference response and to determine the differences between them;
- 3) to achieve the elimination of differences between cadet's and reference responses by means of errors explanations, changes in teaching methods, etc.

The implementation of these three stages will implement the feedback closure principle, which will provide continuous analysis and diagnosis of the main characteristics of training at each stage.

Modern pedagogical researches are devoted to the study of ways and means of improving the education quality while considering all the main components of the training process, their potential is analyzed as well as new training technologies are created, one of the main principles of designing such technologies is compliance with the quality criterion. Such components of the training process are [5]: targeting, stimulating-motivational, informative, operational-activity, control-regulating, evaluative-productive. These components reflect the process of interaction between the teacher and student from the set up training goal to the analysis of its results. The target component of the training process is the formulation by the teacher and the adoption by the students the goals and objectives of the topic (section, course, subject). Goals and tasks of the training process are determined by social orders and specified on the basis of the state educational standards requirements, programs, students' preparation level and material and technical base of the educational establishment. The stimulating-motivational component of the training process reflects the teacher's activities on the cognitive needs formation, learning activities motives stimulation. An informative component of the training process is the content of training which is defined by state educational standards, programs, textbooks and tutorials. Operational-activity component of the training process reflects its procedural characteristics, forms, methods, means of training. The control-regulating component of the training process involves the the teacher's control and the students' self-control in order to establish feedback and adjust the training process course. The evaluative-productive component of the training process combines the teacher's assessment and student's self-assessment of training results establishing their relevance to their goals, identifying the causes of their possible inconsistency, setting up tasks for further activities.

Due to the training process is considered as a system, it is determined not only by the structural components but also by the integral process properties, so all the components of the training process should be considered in a logical dependence. The purpose of training determines its content. The purpose and content of training require certain teaching methods, tools and forms of stimulation and training. In the course of training, current control and regulation of the process is required bringing it closer to the optimal option. Finally, all components of the training process in their totality provide a certain result. It is extremely important to keep in mind that all components of the training process are located in a certain logic, which follows from the regular conditionality of each other. Therefore, in pedagogy, this particular sequence of components of the training process is characterized also as stages.

According to the system theory postulates, if at least one of the system components drops out the system is destroyed. On the contrary, if the structural components of the system and the connections between them increase the whole system increases.

The air traffic controllers' professional training should be considered as a pedagogical system, which has a system-generating factor – the purpose of training, which defines the components integration into the system. The cause-effect relationships find further expression in the purpose and they determine the direction of development and provide the elements relative stability of the professional training structure. All components of the system must be in inseparable unity, as the increasing or decreasing one of them will noticeably affect the state of the whole system in general. The research has found that there are some drawbacks on the part of the control-regulating component of the air traffic controllers' professional training, namely, the inadequate use of the systematic feedback results, making it difficult for the teacher to receive information about the training tasks step-by-step solving quality, about typical drawbacks. This leads to the training correction impossibility, regulation of the training process, changes in the content, methods, forms and means of training. Thus, the integrity of the professional training system is broken which negatively affects the training quality.

To develop and implement the corrective system control, it is necessary to establish aspects of professional training using the cybernetic approach. The analysis of scientific works on the cybernetic approach to aviation operators' training made it possible to identify such aspects as:

1. Preliminary control of knowledge and simulator training results analysis, i.e. there must be information about the initial and current level of cadet knowledge in the given subject area. This information is necessary to generate the structure of the subject that is best suited for this student.

2. Thorough detailing of the subject and duplication of subject elements with varying detail degrees in the material presentation (to provide the cadet with as much material as his current knowledge level requires).

3. Establishment of dependencies between parts of the subject in order of study i.e. in any case, the cadet can not study topic B before studying topic A, if topic A contains the information necessary to understand topic B, and it is reliably known from the simulator training results that the student does not have sufficient knowledge on the topic A.

4. Domination of independent work methods. The cadet carries out research work applying knowledge in similar and modified situations close to real activity.

5. Application of personality-oriented control methods of training and cognitive activity (self-analysis, self-control, self-correction).

6. At the same time, interaction between the following subjects is carried out at every lesson: cadet – cadet, cadet – teacher, teacher – group of cadets, cadet – group of cadets.

Conclusions. Highlighted aspects of air traffic controllers' professional training based on the cybernetic approach will allow the activities decomposition of both the teacher and the cadets in the course of the training lesson providing the simulator training correction. Further directions of the research provide the training lesson structuring, taking into account the most common cadets' mistakes on the simulator, creation of individual training strategies.

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КІБЕРНЕТИЧНИЙ ПІДХІД ДО ПРОФЕСІЙНОЇ ПІДГОТОВКИ АВІАДИСПЕТЧЕРІВ

***Анотація.** У статті розглянута проблема індивідуалізація навчання авіадиспетчерів, основою розв'язання якої є використання кібернетичного підходу до підготовки таких фахівців. Проведено аналіз основних положень кібернетичного підходу та їх адаптації до професійної підготовки авіадиспетчерів з точки зору впровадження контрольно-регульовального компоненту навчання. Обґрунтовано основні аспекти професійної підготовки авіадиспетчерів на основі кібернетичного підходу.*

***Ключові слова:** авіадиспетчер, кібернетичний підхід, зворотний зв'язок, професійна підготовка, корекція тренажерної підготовки, компоненти навчального процесу.*

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