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Technology of Forming the Algorithmic Culture of Future Teachers in the Distance Learning Conditions

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Abstract
The article reviews the technology of forming the algorithmic culture of future teachers in the distance learning conditions. In connection with the spread of educational technologies, the compilation of the action plans becomes an essential component of the future teacher's activity, an integral part of his professional and pedagogical culture. We revealed the substantive and technological essence of forming the algorithmic culture of future teachers in the educational process of university during the distance learning. We have shown that the use of diagnostic, constructive, activity and evaluation stages of the process of forming the algorithmic culture on the basis of distance learning, specially organized systematic work on the given algorithms, purposeful algorithmization of the educational material ensure the effectiveness of solving the problem of preparing students for pedagogical activity on an algorithmic basis.

Keywords: algorithmic culture, technology, future teachers, distance learning.

Introduction

The compilation of the action plans becomes an essential component of the modern teacher's activity, an integral part of his professional and pedagogical culture. Therefore, forming the algorithmic culture of future teachers, contributing to the universalization of the future specialist's qualities has some priority. A high level of the teacher's algorithmic culture guarantees the effectiveness of solving the pedagogical problems. In this regard, the task of forming the algorithmic culture of future teacher is being actualized in the higher school educational process within the framework of distance learning, which should freely orient in a large information flow, be constructive, be able to make decisions independently and learn new methods, forms and means of teaching, including using the developed experimental technology.

The analysis of scientific literature enables to distinguish a contradiction between the existing traditional approach to forming the algorithmic culture of future teachers in a pedagogical university and the need to improve this process in the technological and content aspects. In the terms of technology - using the experimental educational technology, in the terms of content - improving the algorithmic preparation of future teachers, saturating it with various new ways of creating the pedagogical activity algorithms. This contradiction have served as the basis for determining the research problem: what are the essence and content of forming the algorithmic culture of future teachers based on the distance learning technology?

Material and Methods. The problem solution is provided by using a set of methods: theoretical analysis, observation of interrelated activities of teachers and students in the course of training, questionnaires, analysis of training sessions, testing, experiment, methods of mathematical statistics.

The algorithmic culture of a future teacher as a component of professional and pedagogical culture is a systemic formation characterized by a certain level of developing the algorithmic values, knowledge and skills, and reflects the way of activity self-organization in the information society. The main goal of distance learning is to provide the students with the opportunity to independently acquire knowledge in the course of solving practical problems or problems requiring the knowledge integration from different subject areas [1]. The learner constantly performs practical tasks, acquires stable automated skills, organizes his activity algorithm. The technology of forming the algorithmic culture of future teachers in the conditions of distance learning not only increases the volume of the material studied within the discipline and enables timely and objectively manage the student's educational and cognitive activities, but also helps to organize their independent work, promotes the development of ability to use various

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information sources for searching for the decision algorithms, their implementation in various situations [2-5].

To obtain a holistic view of the peculiarity of the process of forming the algorithmic culture of students of pedagogical specialties on the basis of distance learning technology, we consider the structural and content model of the process under study, including the presence of such structural components as target, content, operational, criterial and resultant [6]. The target component focuses on raising the level of the algorithmic culture maturity of future teachers. The content component reflects the content of forming the algorithmic culture of future teachers, represented by the axiological, cognitive, technological and creative components. The operational component reveals the technology of forming the algorithmic culture of future teachers in the distance learning process, consisting of successive stages: diagnostic, constructive, activity and evaluation. The criterion component provides an assessment of the level of maturity of the algorithmic values, knowledge and skills of future teachers. The effective component includes criteria and indicators for evaluating the process of forming the algorithmic culture of future teachers [7].

The process of forming the algorithmic culture of future teachers included four consecutive stages: diagnostic, constructive, activity and evaluation. The research base was represented by the Belgorod State National Research University. In the experiment, which took place from 2013 to 2016, 360 future teachers took part, including 120 students of the experimental group of the philological, biology and chemistry departments and the faculty of Romano-Germanic philology of the university. The results of primary diagnosis revealed a generally unacceptable level of algorithmic culture of future teachers. It was revealed an insufficient supply of algorithmic values, knowledge and skills. The distance educational process, focused on the use of algorithmization elements, was hampered by the lack of possibility of creative implementation of the tasks for developing the algorithmic culture. The analysis of empirical material showed that an optimal level of the algorithmic culture maturity was had by 11% of 360 students. Few students (26%) demonstrated an acceptable level, 35% of future teachers were able to just orient themselves in the algorithmic concepts and sought to work independently. 28% of students had the inadmissible level of the algorithmic culture maturity.

The constructive technology stage was directed to the development of the educational and methodological complex, practical tasks, the definition of the system of forming the algorithmic culture of future teachers in the distance learning process. The teacher's activity included setting the goals and tasks, discussing the algorithm of the forthcoming work, consulting, demonstrating certain methods of algorithmic activity, helping in choosing the solution scheme (algorithm) [8]. The students showed activity in the selection of additional material and preparation of presentations, performed the creative projects, compiled an algorithm for their own activities in the context of distance learning. Thus, the teacher helped the students to build their algorithmic activities, included them in the context of implementing the algorithmic approach at this stage. Such joint work saturated the distance learning environment with the activity algorithms.

The goal of the technology activity phase was to introduce the experimental system of education into the educational process of the university. During the formative experiment, the teacher directed students to successfully master the algorithmic knowledge and skills. The students' activity consisted in mastering the algorithmic methods of solving the pedagogical problems. The practical tasks were presented in the form of laboratory works, accompanied by the presentations. These works proposed the algorithms for solving pedagogical problems, for example, keeping a class journal with the information about students according to a given algorithm. The differentiated tasks made it possible to assess the future teachers' ability to apply the proposed algorithm in the new conditions. The works were mainly carried out independently with dosed consultations given by a teacher, so each student had the opportunity to compose his own algorithm of performing laboratory tasks in the distance learning process. The result of mutual consultations was the fact that the teachers did not conduct seminars until the relevant topic of the elective course was studied. In the classroom, the teacher designated the work plan for the students: studying the theoretical material both in an independent mode and with the help of the teacher's

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consultations; it was necessary to perform practical and laboratory tasks, including not only tasks for the implementation of algorithms, but also some pedagogical tasks requiring knowledge of the algorithmic approach at the end of each topic; boundary and final testing. Each completed task and laboratory work were recorded by the students in their electronic workbooks, which facilitated the process of timely monitoring by the teacher.

The students who have well mastered the necessary algorithms could operate on the reduced knowledge in solving the algorithmic problems, including complex ones, but they did not spend efforts on finding solutions to particular problems based on the algorithm application. The observation has shown that the work on algorithms develops the interest of future teachers in the pedagogical activity. The ability of future teachers to formalize their reasoning and the entire course of solving the pedagogical problems in the form of a table or a block diagram increases the level of algorithmic culture development, becomes a necessary practical quality, facilitates a more rapid and conscious mastery of algorithmic language in the future [9].

At the estimated stage of the technology, it was determined the final level of the algorithmic culture maturity of future teachers in the distance learning process. The teacher's activity consisted in diagnosing the level of the algorithmic culture maturity of students according to the selected criteria, evaluating the results obtained during the technology implementation, identifying the difficulties of the learners and analyzing the problems, correcting the system of forming the algorithmic culture, summarizing and recording the results.

Results and Discussion. Analysis of the algorithmic culture maturity of future teachers in the distance learning process was carried out using the adapted methods, as well as the test and questionnaire materials based on the selected criteria and indicators (attitudes to professional and pedagogical activity under the following indicators: interest in the professional and pedagogical activity and setting for the use of algorithmic values, knowledge and skills in the professional and pedagogical activity); algorithmic knowledge on such indicators as completeness and awareness of algorithmic knowledge; algorithmic skills in terms of the effectiveness of algorithmic skills; creativity of algorithmic actions under the indicators: originality of algorithmic actions and independence of algorithmic activity.

Maturity of the axiological component of the algorithmic culture was determined with the help of the questionnaires "Motives for choosing the teacher's activity", "Assessment of the professional orientation of the teacher's personality". The cognitive component was evaluated through a test in which the tested persons were asked questions related to the basic algorithmic concepts and skills. They had to be correlated or it was necessary to choose one of many answers; end the formulated definition, establish the correct or incorrect proposed statement. The technological component of the algorithmic culture was defined as a result of the students' practical work stipulated by the program of the educational and methodical complex "Algorithmic Foundations of Pedagogical Activity". The level of forming the creative component of the algorithmic culture was determined with the help of a set of creative tasks that had the increasing levels of independence and creativity. For example, the students were asked to compose graphical algorithms of actions in a lesson on a particular topic. Future teachers had to independently use the obtained algorithmic knowledge and methods of algorithmic activity in the non-standard, non-algorithmic situations, complementing and suggesting other ways of solving the problem, reasonably choosing the best option. The level of the creative component maturity was determined as a result of expert assessments. The essence of the tasks was as follows: The students were instructed to consistently describe the steps that are necessary to carry out the assigned task on a particular topic. They were given 30 minutes for the exercise. At the same time, the experts represented by the university teachers, who conducted lessons on the experiment program, evaluated the results of task performance. The experimental technology of teaching allowed building the individual educational trajectories by providing the interactive interaction of students with the information and educational environment. Due to the interactive style of communication and operational communication in the distance learning mode, the students were offered additional blocks of educational material and links to information resources depending on real educational achievements. The lectures were conducted with the help of television

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broadcasts, consultations in the form of chat rooms or forums, seminars in the form of computer conferences.

Figure 1 presents the final results of the experimental work.

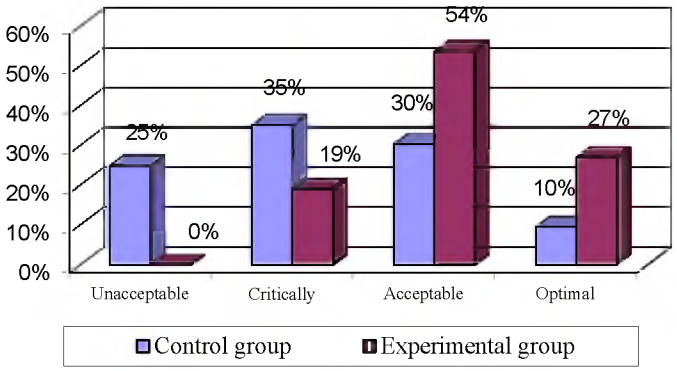

Figure 1. Diagram of the formation of future teachers' algorithmic culture at the stage of the formative experiment.

The positive dynamics of the acceptable (from 30% to 54%) and optimal (from 10% to 27%) levels of forming the algorithmic culture of future teachers on the basis of distance learning testifies to the effectiveness of the applied technology in the experimental group. To increase the level of algorithmic culture, 19% of the students remained at the critical level, in our opinion, need a longer time, further search for effective methods, development of the typological features adapted to this group of future teachers, differentiated tasks for compiling various algorithms of pedagogical activity [10].

It has been revealed that an increase in the average score in the sample is not accidental, but is very likely to be natural. Let us denote: S_1 – standard deviation in the control group, S_2 – standard deviation in the experimental group, σ – standard deviation, $\overline{X}$ – mean value in the experimental group, μ – mean value in the control group. Since the sample size is greater than 30, then the mean value over the sample has a normal distribution according to the central limit theorem. Let us formulate the null and alternative hypotheses in formulas (1), (2):

$$H_0 : \mu = 37.5 \quad (1),$$

$$H_A : \mu > 37.5 \quad (2).$$

Let us calculate the test statistics in the formula (3):

$$z = \frac{\overline{X} - \mu_0}{s_1 / \sqrt{n}} = \frac{53.9 - 37.5}{18.64 / \sqrt{120}} \approx 9.5 \quad (3).$$

Let us define from the tables of normal distribution $z_{0.01} = 2.33$. Based on this, we reject the null hypothesis at a significance level of 1%. Thus, an increase in the average score is naturally more than 99%.

To evaluate the results of the experimental work efficiency, we used the Fisher criterion, the value of which was calculated in the Ms Office Excel. Let us find the variances of the control and experimental groups in formulas (4), (5) and calculate the criterion F by the formula (6):

$$d_1 = s_1^2 = (18.64)^2 = 347.45 \quad (4),$$

$$d_2 = s_2^2 = (13.8)^2 = 190.44 \quad (5),$$

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$$F = \frac{d_1}{d_2} = \frac{347.5}{190.44} \approx 1.83 \quad (6).$$

From the table with 119 degrees of freedom for both variances at the significance level $\alpha = 0.05$ we find $F_{0.05} = 1.16$. As $F > F_{0.05}$, it can be argued that, there are differences between two samples according to the levels of the algorithmic culture maturity at a significance level of 0.05.

The changes that occurred during the experiment are caused, first of all, by purposeful work on forming the algorithmic culture of future teachers within the framework of the technology developed by us, which was implemented in the experimental group. 19% of students remained after the formative experiment testify to the difficulties they encountered in forming the algorithmic culture at a critical level. To increase the level of algorithmic culture of such students, in our opinion, it is needed a longer time, further search for effective methods, development of the typological features adapted to this group of students, differentiated tasks for compiling various algorithms of pedagogical activity.

After the formative experiment, the maximum changes in the sample heterogeneity were recorded in the students with an unacceptable level of the algorithmic culture maturity, the minimum ones - in the students with an acceptable level of the algorithmic culture maturity. The technology used to form the algorithmic culture of future teachers was the most effective in the field of reducing the number of students with an unacceptable level of the algorithmic culture maturity.

As a result of experimental work, it is established that the use of technology of forming the algorithmic culture of future teachers in the distance learning process is not only an effective means of improving the quality of knowledge and development of professional and pedagogical culture, but also contributes to the solution of pedagogical tasks in the non-standard situations.

Conclusion. The effectiveness of technology of forming the algorithmic culture of future teachers in the distance learning process, as shown by the study, is due to the implementation of the following pedagogical conditions: motivational and value readiness of students to forming the algorithmic culture at each stage of technology implementation; construction of an individual trajectory of the future teacher's education due to the interactive interaction of students with the information and educational environment; program and methodical support and organization of monitoring of the process of forming the algorithmic culture of students.

Summary. The research proves that the developed technology of forming the algorithmic culture of future teachers in the distance learning process, including the sequence of stages of joint activity of the students and a teacher, a system of algorithmic study assignments and special exercises enable to form the algorithmic culture of students at a sufficient level. It is important to take into account the gradual increase in the volume and complexity of study assignments designed for self-fulfillment by the students, the need to change the structure and content of assignments, the transfer of role positions through the experimental teaching technology, the use of a wide range of visual-didactic means.

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