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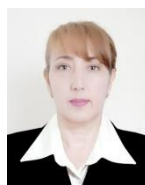
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PROGRAM-METHODOLOGICAL COMPLEX AS A MEANS OF IMPROVING THE QUALITY OF LEARNING IN HIGHER EDUCATIONAL INSTITUTIONS

Abstract: The article considers issues related to the use of information technology in teaching the subject “Theory of Algorithms”, highlights some of the features of teaching this academic discipline. The factors that contribute to the effective assimilation of educational material in this subject are formulated. The main aspects and goals of the methodology of using the program-methodological complex developed in support of the subject “Theory of Algorithms” are given. The results of a pedagogical experiment are described as part of a study on the methodology of teaching the subject “Theory of Algorithms” using a software-methodological complex.

Key words: educational process, “Theory of Algorithms”, program- methodological complex, teaching methodology for the subject “Theory of Algorithms” pedagogical experiment.

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Introduction

At present, the most important component of the modernization of education is the change in the requirements for a university graduate. The modern system of higher education should shape the future specialist and prepare him for future professional activities. A complex set of qualities that a modern specialist should possess can be developed by a system in which everything positive that is in traditional training will be used, and new, rational approaches will be introduced to compensate for the shortcomings of the existing system in their mutual complement. The basis of training is the implementation of educational programs in various fields. One of them is an educational program for the preparation of a bachelor of applied mathematics and computer science. The areas of professional activity of the bachelor of applied mathematics and computer science are research centers, government bodies, educational institutions and organizations of various forms of ownership, using methods of applied

mathematics and computer technology in their work. Bachelors of applied mathematics and computer science are mainly preparing to carry out research in areas using applied mathematics and computer technology, to develop and apply modern mathematical methods and software to solve problems of science, technology, economics and management, to use information technologies in design, managerial and financial activities. And also they are prepared for pedagogical activity as a teacher in high school or college. One of the components of the block of general professional disciplines of the educational program in this area is the subject “Theory of Algorithms”. The course “Theory of Algorithms” refers to fundamental disciplines, is the most important in the system of training students (bachelors) in areas related to the field of computer science. The theoretical provisions of the course “Theory of Algorithms” are the basis for the successful development of related disciplines. This implies the importance of the course, which it occupies as the theoretical basis of the modern theory

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of programming, the construction of algorithmic languages and computers, the analysis of algorithms in order to choose the most rational computer solution and, finally, the analysis of algorithmic languages and their syntactic control in the development of translators. The high abstractness of the content, its fundamental and theoretical nature makes the course difficult for students to master. This is due to the need for the student to have a certain level of abstract thinking for the conscious assimilation of the teaching material of the course "Theory of Algorithms" and the acquisition of specified subject competencies. In this regard, the urgent problem of designing a teaching methodology for the course "Theory of Algorithms" by means of a program-methodological complex that provides a high level of subject competence in accordance with the requirements of the state standard. The teaching methodology is based on the use of visualized teaching materials as part of the program-methodological complex in the educational process using the means of information and communication technologies (ICT), which ensure a conscious perception of the course content. The results of such training are expressed in the achieved level of subject competence in the theory of algorithms.

Overview of the problem.

Theory and practice of teaching the course "Theory of Algorithms", as well as the subsequent development of a methodology for teaching theory of algorithms, were dealt with by V.I Igoshin [1], A.V. Golanova [2], I. D. Koldunova [3] and others. Their work is devoted to the construction of methodological training systems for the course "Theory of Algorithms", which are based on the logical-semiotic approach (A.V. Golanova), system-activity approach (E.N. Bobonova). Works by V.I. Igoshin is dedicated to building a model of fundamental mathematical training for future teachers of mathematics and computer science at a pedagogical university in the field of disciplines of discrete mathematics, which includes logical and logical-didactic components. Training in accordance with such a model will allow, in his opinion, future teachers to effectively master both methods of logical reasoning and evidence, and applied tools of discrete mathematical sciences. In the work of I. D. Koldunova, the methodology of teaching students the course "Theory of Algorithms" on the basis of analytical and synthetic activity is considered. A significant contribution to the teaching methodology of the discipline "Theory of Algorithms" was made by V.L. Sailors. In 1989, the course of theory of algorithms was singled out as an independent separate discipline, a discipline program was developed and the first textbook was written [4].

After analyzing the existing teaching methods of the "Theory of Algorithms" course, it can be concluded that understanding the content of the

fundamental disciplines of subject preparation contributes to the formation of a future science teacher in computer science, an appropriate informational, mathematical culture, as well as providing the base necessary for future professional activities. Given the specifics of the concepts that operate with the fundamental disciplines of subject preparation, including the "Theory of Algorithms", namely, their formalization and a high degree of abstraction, the learning process should be built using methods and means that ensure its maximum visibility, strict consistency of presentation, which can support theoretical students thinking [5]. The main objective of the course is to introduce students to the means that allow the transition from an informal statement of the problem to its description in the form of a formal system. The traditional teaching materials of the course "Theory of Algorithms" (textbooks, teaching aids and task books) reflect the system of didactic units of the discipline, but they do not have a high degree of visibility necessary for a generation whose living information space is shifted from text to figurative, visual. These limitations of teaching aids prevent students from deep understanding of the content of the course "Theory of Algorithms" and mastery of fundamental subject skills. Despite this, the studies do not pay enough attention to the features of developing a holistic methodological training system based on the use of ICT tools, do not take into account the features of the specialties in which the discipline is studied, and does not examine the impact of the use of ICT tools on the quality of education [6].

In view of the foregoing, we get a contradiction: on the one hand, the theory of algorithms is one of the most important sections of the university course of disciplines related to areas related to information technology, in particular applied mathematics and computer science, and, on the other hand, there is insufficient methodological elaboration of content, organizational forms and teaching methods for this section of computer science and mathematics, there is a lack of teaching and methodological aids in the Uzbek language. This determines the relevance of the study, consisting in eliminating this contradiction.

Material and research methods

The issues of organizing the educational process using program-methodological complexes (PMC) in disciplines related to the theory of algorithms and algorithmization are still open, an integrated methodological system for teaching theory of algorithms based on the use of specialized software products has not been defined. One of the ways to eliminate this contradiction is the use of ICT used in the organization of the educational process at a university in disciplines related to the theory of algorithms. One of the priority areas for the use of ICT in the educational process is the creation of electronic educational tools (EET) [7], the use of which allows

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to increase the effectiveness of training by reducing the time of mastering the material and, therefore, expanding the range of questions studied, revealing the intellectual potential of students, developing them cognitive interest, which will provide an incentive for subsequent active independent work.

Among EET, a special place is occupied by program-methodical complexes (PMC). The development and use of the PMC in the educational process allows us to successfully solve new problems of education, the emphasis is shifting from the receipt by students of a certain amount of knowledge to the development of their skills and skills for the independent acquisition of this knowledge, which corresponds to the concept of a competency-based approach. Obviously, with the advent and improvement of the curriculum, lecture plans and practical classes, as well as the role of the teacher in the educational process, should fundamentally change i.e. a reorganization of the methodological training system is necessary, taking into account the features of educational activities based on the use of the PMC.

Results

The pedagogical experiment on the object of research was carried out in three stages: search-stating (2014-2016), formative (2016-2018) and control and evaluation (2018-2020). At each stage, their goals are set and specific research tasks were solved. The control and evaluation stage of the pedagogical experiment was carried out on the basis of three higher educational institutions for two years

(2018–2020). By tradition, the groups were divided into two approximately equal subgroups: experimental (EG) and control (CG). Groups were formed in such a way that they were comparable in terms of basic indicators of equality of initial conditions, significant from the point of view of the study. Education in the experimental groups was carried out using the developed PMC, in the control groups using traditional methods, without resorting to the developed programmatic and methodological materials.

The effectiveness of the developed teaching methodology based on the PMC was tested according to the following criteria: the degree of students' knowledge of the basic algorithms, methods for constructing algorithms, methods for calculating the complexity of algorithms, and basic knowledge of the theory of algorithms; skills to develop algorithms for specific tasks; determine the complexity of the algorithms; apply the acquired knowledge in solving assigned tasks. The experiment included intermediate tests and final testing. The table below shows the results of the final testing of the experiment. The main results were obtained in the process of teaching the subject "Algorithms" and "Theory of Algorithms". The experiment was attended by students of 1-2 courses of educational areas "Methods of teaching computer science" (group no. 1, no. 2, no. 3) and "Applied mathematics and computer science" (group no. 4, no. 5). The percentage of students' grades before the experiment (BE) and after the experiment (AE) are shown in Table 1.

Table 1. Percentage of results of final tests conducted as part of a pedagogical experiment

Subgroups	Amount of students in groups	Testing steps	Low degree (%)	Medium (%)	High degree (%)	Percentage increase in high and medium ratings
CG no.1	27	BE	70	30	-	-
		AE	74	26	-	
EG no.1	26	BE	69	31	-	19%
		AE	30	46	4	
CG no. 2	22	BE	55	45	-	-
		AE	59	41	-	
EG no. 2	20	BE	60	35	5	20%
		AE	40	35	25	
CG no. 3	27	BE	59	41	-	-
		AE	59	30	11	
EG no. 3	26	BE	62	38	-	24%
		AE	38	27	35	
CG no. 4	24	BE	50	50	-	4%
		AE	46	54	-	
EG no. 4	20	BE	55	40	5	20%
		AE	35	50	15	
CG no. 5	24	BE	50	29	21	-

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		AE	50	34	16	
EG no. 5	24	BE	46	38	16	17%
		AE	29	25	46	

The table shows that in the control groups, the quantitative increase in students who received average and high marks was 0-4%, which is insignificant. If we compare this increase in the experimental groups, then it is 17% -24%. Data on the increase in the percentage of average and high marks of students of

experimental groups indicates an increase in the quality of the study of the subject "Algorithms" and "Theory of Algorithms". Below is a diagram reflecting the overall results of the experiment (Fig. 1).

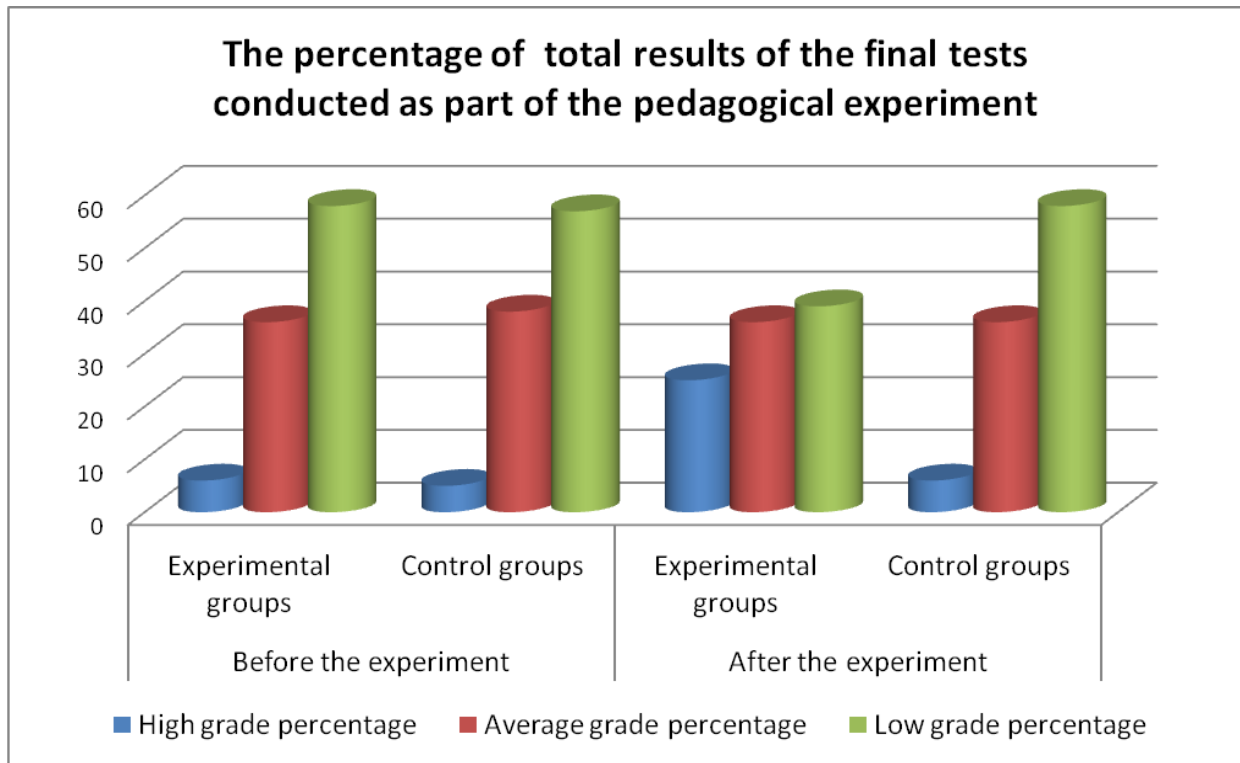


Fig. 1. The percentage of total results of the final tests conducted as part of the pedagogical experiment

To analyze the results of a pedagogical experiment, methods of mathematical statistics were used [8]. Sample mean values (\bar{x}, \bar{y}), the validity interval (confidence interval), and the efficiency

coefficient of the overall results for the control and experimental groups were calculated. The resulting statistics are shown in table 2.

Table 2. General results of final tests conducted as part of a pedagogical experiment

	Experimental groups n=116			Control groups m=124		
Ratings	5	4	3	5	4	3
The number of relevant ratings	29	42	45	7	45	72
Sample averages	$\bar{x}=3,86$			$\bar{y}=3,47$		
Efficiency coefficient	$\bar{x}/\bar{y}=1,11$					
Validity interval	$3,7164 \leq 3,86 \leq 4,0031$			$3,3640 \leq 3,47 \leq 3,5759$		

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Conclusion.

In the course of a theoretical and experimental study of the scientific problem posed in accordance with the purpose and objectives of the study, the following conclusions and results were obtained:

1. As a result of the analysis and research of existing approaches and methods of using PMC in education, the main goals of using PMC in the process of teaching the discipline "Theory of Algorithms" and related disciplines are determined. This made it possible to determine the main directions and requirements for the use of the PMC in the educational process of the university, which opens up new possibilities for improving the process of teaching the subject and maximizes interest in the study of the subject.

2. The structure of the educational material and the methodology for conducting classes on the subject "Theory of Algorithms" using the PMC [9] are developed.

3. Methodological methods for the use of PMC are developed. The sequence of tasks presented corresponds to the logic of the formation of the final knowledge, which, according to the methodological approach, is composed of a chain of certain skills. For each of the sections, the requirements for initial training, preceding the study of this section, as well as the requirements for knowledge and skills at the end of the study, distribution were identified.

4. Based on the developed methodology, a program-methodological complex is implemented.

5. The effectiveness of the developed methodology for the use of PMC was proved during the experimental work carried out over several years.

6. The research hypothesis was confirmed that if students are taught the basics of the theory of algorithms according to the proposed methodology using the PMC, this will improve the efficiency of the educational process and the quality of learning material: students spend significantly less time on research; due to graphical capabilities, problem solving becomes more visual; regular use of a computer allows students to treat software tools as convenient working tools; the use of PMC makes it possible to concentrate on the substantive part of the material being studied, to study the qualitative features of its behavior, without being distracted by the technical implementation.

7. The use of the PMC gives integrity to the educational process, allows the teacher to raise the organization of the pedagogical process, preparation and conduct of classes to a higher level. PMC is an important means of a more perfect organization of pedagogical work. By mobilizing the existing knowledge and experience to solve certain pedagogical problems, carrying out the analysis and introspection of pedagogical activity in the course of work on the curriculum, the teacher fundamentally increases his professional competence. Thus, the creative process of working on PMC, a product that meets the time in which the functional role of each of its components can change under the influence of many factors, can be considered as a means of improving the quality of education.

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