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METHODS OF TEACHING LANGUAGES PROGRAMMING BASED ON THE DESIGN METHOD

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Annotation. If we turn to scientific, methodological, regulatory documents and literature on teaching students the basics of programming, then the state standard does not specify any programming language, but only the essence of what knowledge and skills students should have, and also lists the main components of learning a programming language at school.

Keywords: Python, conditional operator, programming languages, lesson, students, teacher, research, knowledge, solution, training.

The programming course studied in this paper in the conditions of a general educational organization is traditionally introduced into the curricula for the preparation of future graduates, and the knowledge and skills acquired during training are significant tools for the subsequent activity of a student in the process of acquiring professional competencies in the framework of continuing education. It is important to note that learning programming allows you to activate the development of cognitive abilities (algorithmic, systemic, specific thinking) since it acts as a systemic intellectual activity.

However, despite a rather huge layer of work carried out in the field of methodological study of the theory and practice of teaching programming in the conditions of the education system in general and schools in particular, many issues of improving the existing methodological systems remain in the space of relevance. In modern conditions of transformational processes of the educational system, when introducing and implementing the educational paradigm, serious requirements are imposed on the programming course, considering them as effective metacognitive means that allow forming all the necessary competencies of a student of a general education organization.

However, the theoretical analysis carried out by us in the framework of the study allowed us to draw a particular conclusion that the programming teaching methods currently used are somewhat one-sided, since they focus on the content component of the methodological system, i.e. they are mainly "devoted" to the choice of specific mathematically-oriented tasks. Also, it should be emphasized that the traditionally applied methods of teaching programming, being evaluated, first of all pay attention to the activity aspect of programming.

In the context of the above, we came to the conclusion that it is necessary to develop and scientifically substantiate a more effective methodology for teaching programming to students of general education organizations from the standpoint of the basic requirements of the design method and the cognitive approach to the learning process. This conclusion is supported by the fact that the success (quality) of programming training in most cases is due to a whole complex of interrelated factors, the contact of which is due to a number of objective and subjective reasons.

In this case, we attributed to subjective reasons the unwillingness of the majority of students to carry out independent educational activities, a relatively low level of theoretical awareness, and as a consequence, low motivation for the educational process of cognition. Especially, I would like to emphasize that the majority of modern schoolchildren demonstrate the so-called "clip" thinking, which is quite common and more characteristic of the modern "network" generation of students. This is reflected in the "heterogeneity" of students, which is manifested in the experience of practical programming.

The objective reasons that can significantly affect the degree of success of students in mastering the programming course include the complexity of the theory and practice of programming, especially in the case when the student initially demonstrates low performance in such an academic discipline as mathematics. Thus, the monitoring carried out within the walls of the Siberian Federal University (2017-2020), focused on establishing the level of entrance knowledge in mathematical disciplines, confirms the relatively low level of knowledge demonstrated by applicants (see Figure 1). In addition, scientists note that this has a tendency to increase.

Figure 1 □ Results of monitoring the level of entrance knowledge in mathematical disciplines of applicants of the 2017-2020 KDPI.

The negative trend indicated in Figure 1 gives every reason to talk about the existing problems in the organization of the educational process, the purpose of which is to teach programming that require resolution or some kind of "smoothing" through the development of a scientifically based methodology.

The currently effective methodology of teaching programming to students of general education organizations should be aimed at assisting them in mastering practical programming skills, without ignoring the importance and necessity of developing specific styles of thinking, which mainly relate to mathematical ones. Also, of no small importance are such motivational and value qualities of students, which are expressed in the ability and desire to independently acquire the necessary knowledge throughout life. Within the framework of the purpose of this study and the tasks set to achieve it, we turned to the potential of the projective approach, the provisions of which, in our opinion, will allow us to overcome obstacles on the way to a given learning goal.

The basis of the design method is the main provisions of the cognitive approach, formed on the basis of conceptual ideas of cognitive science. The application of the design method will allow linking a number of components of the learning process into a single whole, without ignoring the importance of purposeful and consistent development of the student's thinking in a general educational organization, built on the basis of his mental experience. Thus, the essential basis of the design method is the ability to think, analyze, and effectively master the knowledge offered in the framework of the program material, to form the necessary skills and abilities.

The key concept of cognitology is the cognitive (mental) scheme, which, according to U. Neisser should be considered as a generalized visual education resulting from the integration of the processes of visual, auditory and tactile-tactile impressions. Basically, cognitive schemas have a complex hierarchical structure, represented as a system (network) of schemas. In the context of the above, it can be concluded that the degree of success in learning is largely due to the number, variety, saturation of cognitive schemes and the strength of the relationships between them.

Based on these provisions, we presented the process of learning programming in the form of a process focused on the formation of students' mental schemes, among which two were identified (see Figure 2)

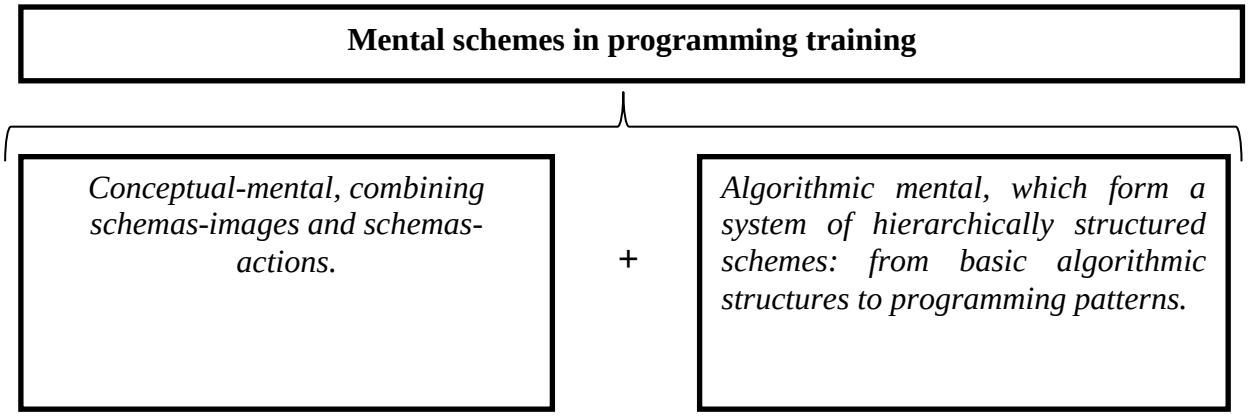

Figure 2 □ The process of forming mental schemas in students during programming training

Referring to the scheme presented in Figure 2, attention should be focused on the special importance of the formation of schemes of the second type, this is due to the fact that, based on mental experience, it becomes possible for the student to further advance from the initial stages of programming to a higher level of mastery of the process under study. The implementation of the design method based on the basic provisions of the project approach is possible with the active use of modern innovative technologies, including cognitive ones, which have proven their success in the education system.

Project-based learning technologies are a set of methods, techniques, and tools aimed at the intellectual development of students with mandatory consideration of their individual mental characteristics. The purpose of using project technologies in the course of teaching programming to students of general education organizations is to improve perception and understanding, which together allows to significantly increase the degree of efficiency of mastering program material.

A significant role in the development and activation of cognitive processes of students is played by a set of tools designed to enhance the visualization of the process of knowledge acquisition, which is achievable through the use of conceptual and mental maps. The first of these maps, proposed by D. Novak, is used in order to systematize a set of concepts that acquire a hierarchical structure with clearly identified structural relationships characterized by the force of interdependence. In order to achieve maximum efficiency in their application, examples are placed on the conceptual map that activate the understanding of the displayed concepts.

For the first time, the term "mental maps" ("mind map") was proposed by T. Buzen, at whose suggestion they looked like special radial schemes with the image on them of logical relationships of the whole set of issues affecting the problem or the concept being mastered. During the development of the mental map, associative relationships formed between concepts are used. In the course of the study, we came to the conclusion that it is advisable to use concretized and partially formalized mental maps within the educational process, the tasks of which include programming training, which differ in areas, in particular:

□ a training conceptual map on which a single (one concept being studied) educational information is reflected by means of graphics;

an algorithmic mental map that includes an algorithm for solving a problem, presented in the form of an individual solution, including the possibility of forming dead-end branches with the subsequent choice of the correct solution.

Such a map can be represented in a software implementation, which will allow it to act as a formal description of the algorithm. In order to increase the efficiency of the process of teaching programming to students of general education organizations, it is necessary to develop and put into practice maps, in the construction of which the students themselves will be involved, which makes it possible to increase the effectiveness of the educational process by equating the above-mentioned maps to the means of visualizing knowledge and at the same time to software products. Also, during the development of maps, it is possible to evaluate the results of programming training.

In the process of constructing conceptual and mental maps, in our opinion, it would be advisable to use a projective-recursive strategy, in which a projective methodological system, presented as an open system, is modeled and subsequently develops in the form of a project with specific characteristics and behavior at the current time and in the future. All actions used within the framework of the above strategy, initiation, modeling and implementation of a

projective methodological system for teaching programming to students of general education organizations involves the design and dynamic development of all elements included in the system with the involvement of all subjects of the studied process: students and teachers.

The projective-recursive strategy applied within the framework of the educational process at school is built on the basis of compliance with the requirements specified in two basic principles: 1 principle the principle of projectivity, determines the need to impose the future activities of students on the present educational process, within the framework of which the modeling of conditions is carried out that allow the most effective solution of the tasks assigned to students; 2 principle the principle of recursiveness provides for the creation and use of electronic learning resources.

Next, we will focus on the practice of applying and updating the components of the methodological system for teaching programming of the projective-recursive strategy in the conditions of the implementation of the learning process in general education organizations. Initially, it is necessary to pay attention to the fact that in the architectonics of the methodological system, a number of components are traditionally distinguished, among which are: target, content, technological (methods, means, forms), performance-evaluation (diagnostic tools for diagnosing and evaluating the process of mastering knowledge by students).

Within the framework of the traditional scheme, the target component includes the leading goal of the educational process, which is to achieve specific, diagnosable learning outcomes represented by three levels:

 disciplinary level, within which the formation of specific competencies in the educational section programming is carried out;

 the professional level at which the formation of special competencies of the program material takes place;

The meta-disciplinary level at which the development of algorithmic and systemic thinking of students is carried out.

It should be noted that the meta-disciplinary level determines the dynamics of the formation of the entire complex of necessary competencies due to the development of algorithmic and systems thinking, which, in fact, allows us to talk about its hierarchical significance among the others named. However, the existing interdependence between all components ensures the development of all necessary competencies relevant to the field of programming, including algorithmic and systems thinking, thus forming a single system of recursive goals and at the same time the results of the educational process.

In the process of developing the content component of the methodological system, which is a projection of the goals and results of the learning process, we came to the conclusion that it is necessary to move somewhat away from the traditionally recognized algorithm for solving typical tasks offered to students within the section of the Computer Science programming subject. In our opinion, all work on the construction of a methodological system should be coordinated with the following areas:

1) solving practice-oriented tasks that include elements of advanced training. Thus, tasks from parallel mathematical disciplines should be introduced into the learning process;

2) the inclusion of students in the process of creating tests that imply knowledge of syntactic, semantic and pragmatic features of YAP, i.e. encoded in a given language. Attention should be focused on the scientifically-based fact of increasing students' understanding of educational material in the course of self-performed work;

3) involving students in practical work on the creation of interschool cooperation projects, through which the implementation of cooperation between students and teachers of various educational organizations and IT business projects is achieved.

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