Mental Enlightenment Scientific-Methodological Journal

Volume 2022 / Issue 4 **Article 26**

USE OF A SYSTEM-PROBLEM APPROACH IN THE FORMATION OF ALGORITHMIC COMPETENCE OF STUDENTS

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Mental Enlightenment Scientific-methodological Journal
June, 2022, № 4

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Abstract. This article discusses the application of a competency-based approach in teaching programming to students in higher education institutions. The structural elements of algorithmic competence, which are formed at different stages of training in the process of professional training of future specialists in the field of information technology, are described.

Keywords: algorithmic competence, algorithmic competence, system-task approach, programming, problem, system-problem approach.

INTRODUCTION

Today, the development of technology is developing very fast. Modern techniques for each field are updated every day and require constant research from a specialist. In this period of development, one of the most pressing issues today is to educate students of higher education institutions in accordance with modern requirements, in accordance with the requirements of employers, able to apply production techniques in practice and work in a team. Many reforms are underway to address these issues and implement them in higher education institutions.

The integration of general and specialized disciplines and the introduction of vocational education in higher education institutions will play an important role in the training of future staff. The teaching of all disciplines should be systematically coordinated, with the sole purpose of training professionals in the field who can adapt professionally to the requirements of the time. Improving the quality of education is one of the most pressing issues in the world community today. To solve it, it is necessary to modernize the content of education, reconsider the technologies of the educational process and the ultimate goal of non-verbal education. In this context, it is necessary to develop the professional competence and professional adaptation of specialists, the ability to apply their knowledge in their professional activities and adapt to the requirements of the employer.

According to MA Innazarov, professional competence is a set of knowledge, skills and abilities, experience, personal qualities based on existing knowledge, experience and ensuring the effectiveness of professional activity in the process of education and socialization, aimed at ensuring independent, successful participation in activities [3].

MATERIALS AND METHODS

Professional competence is the acquisition by a specialist of the knowledge, skills and competencies necessary for the performance of professional activities and their application in practice at a high level. Professional competence implies the acquisition of integrative knowledge and actions in each independent direction, rather than the acquisition of individual knowledge or skills by a specialist. Competence also requires the constant enrichment of professional knowledge, the ability to learn new information, to understand important social requirements, to be able to search for new information, process it and apply it in their work.

Professional competence is manifested in the following cases:

- in complex processes;
- when performing indefinite tasks;
- when using contradictory information;
- being able to have a contingency plan

Professionally competent specialist:

- Consistently enriches their knowledge;
- learns new information;
- deeply understands the requirements of the time;
- seeks new knowledge;
- processes them and uses them effectively in their practice [1].

This article discusses the formation of algorithmic competence in future specialists in the field of information technology in higher education.

The following descriptions of algorithmic competence are found in the literature:

• mastery of algorithms [7];

• "Theoretical Models (Nm) + Algorithms (A) = Algorithmic Competence (Ak)" (Nm + A = Ak) [10];

• modeling and structuring of knowledge, design of algorithms, analysis of algorithms [11].

Algorithmic competence is not only the ability to design, describe and execute algorithms, but also to determine the properties of algorithms, their application to other problems, the algorithmization of unformed problems [13].

Algorithmic competence is manifested in the following forms [14]:

• abstraction, modeling and systematization of knowledge;

• design of algorithms;

• analysis of algorithms;

• algorithmic notation.

To describe the structure of competence, O.N. Yarigin proposed a four-sided, ie "tetrahedral" model: algorithmic (A), linguistic (T), deductive (logical) (D) and inductive (I) (Figure 1)

Figure 1. Tetrahedral model of competence

Competence is manifested through the qualities of the person, represents the formed level of the corresponding competence, is manifested through the motives and values of the person in the process of realization of competence.

Any competence consists of the following three main components: cognitive, integrative-functional, and personal [14].

The cognitive component is concerned with knowledge and the ways in which it is acquired. O.N. Yarigin divided knowledge into declarative (I know, what) and procedural (I know, how) types [12]. Within the tetrahedral model, they are linguistically and algorithmically compatible.

The logical aspect corresponds to the integrative activity component.

The inductive aspect corresponds to the individual component, as reflection, self-development, experience, intuition, and imagination provide for the acquisition of new vague knowledge.

Table 1 presents the subject-level algorithmic co-competence in the projection of different coefficient models of students of higher education institutions.

Table 1. Comparison of different models of competence.

RESULTS AND DISCUSSION

Normative documents of the higher education system of the Republic allow to distinguish certain competencies, criteria for evaluating the results of students' learning activities, science programs, etc., the formation and development of which leads to the formation of algorithmic competence. The identified competencies

allow the formation and development of algorithms and data structures, as well as algorithmic languages and programming sciences in higher education institutions.

K1 - Algorithmic competencies related to the implementation of ready-made algorithms;

K2 - Algorithmic competencies related to the change of the algorithm when the Executor status changes;

K3 - Algorithmic competencies that enable the algorithm to be written using the Executor Command System;

K4 - Algorithmic competencies related to search and correction of errors in the algorithm;

K5 - Algorithmic competencies for the development and implementation of simple algorithms using cycles, branching, auxiliary algorithms.

K6 - Algorithmic competencies in the field of task design;

K7 - Algorithmic competencies that allow the selection of data types for the implementation of the algorithm;

K8 - Algorithmic competence that allows you to write an algorithm in a programming language;

K9 - Algorithmic competencies in the field of program correction;

K10 - Competencies related to programs for the development, design and execution of algorithms for processing digital and symbolic data through cycles, branching, auxiliary algorithms.

K11 - Algorithmic competencies in the field of data storage in computer memory;

K12 - Algorithmic competencies for modeling learning tasks using structured data types;

K13 - Algorithmic competencies applied to the development of algorithms to solve other problems;

K14 - Algorithmic competencies related to the use of controls to develop a program window interface.

K15 - Knowledge of algorithm theory and algorithmic competencies in the development of algorithms and programs using different data structures;

K16 - Algorithmic competence in the field of research activities using knowledge, skills and abilities in algorithms and programming;

K17 - Algorithmic competencies in the field of design activities, manifested in the independent development of finished software products.

K6-K10 competencies develop on the basis of K1-K5 competencies. Thus, K8 algorithmic competence develops on the basis of K3 competence, K9 competence - K4 competence, K10 competence on K5 competence. Competence K1, K2 is transferred to competence K10 and is formed with knowledge and skills related to a specific programming language.

The formation of competencies occurs in such a way that competencies K11 and K12 are improved on the basis of competencies K7, competencies K13 and K14 are developed taking into account competencies K8-K10. Competence K6 becomes an integral part of competence K13. The structure of algorithmic competence K1 – K14 partially meets the requirements for graduates of higher education institutions in the field of algorithms and programming.

Thus, all the emerging competencies are interrelated, the skills and abilities that are based on them are developed on the basis of learning activities, personal qualities are developed on the basis of psychological laws of personality development. The interrelation of competencies formed in the process of studying algorithms and programming in higher education institutions is shown in Figure 2.

Figure 2. Sequence of formation of algorithmic competence.

Since the Tetrahedral model of competence is a complete graph, that is, a graph with each pair of adjacent ends, the formation of competence cannot proceed linearly, because all the components of competence are interconnected and closely related to each other.

The process of teaching in higher education institutions on the basis of a general professional competence approach (Figure 3).

Figure 3. Basics of algorithms and programming of students of higher education institutions and a model of the teaching process based on a competent approach to the science of algorithms and data structures.

An important element of the proposed model is feedback. A special place is given to reflection, which allows to understand the existence of the problem and look for means to solve it. Competences are realized through the content and purpose of learning in the learning process of students, the presence of feedback between these activities and knowledge leads the student to understand the need for independent search for new knowledge to carry out practical activities.

Systematic - Assignment Approach V.A. Adolf and I.Yu. In one of the triads of the competent approach, Stepanova is based on the formation of information competence: knowledge - the task ensures that there is a correct link between knowledge and activity. A system-based approach can be used to implement a competent approach to teaching programming in the general sciences. A system of assignments will be developed for each topic. The system of tasks is built on synergetic principles. The issue of using a synergistic model to teach students programming is addressed in the scientific work of SM Okulova.

The methodology for building a task system includes the following steps:

-Define the fundamental components of systems: They are determined by the goals, objectives and content of the curriculum.

-Choose the initial issues (tasks) that cover the fundamental components of the system. Teaching to solve such problems is carried out "by imitation and experience." This is the stage of the linear development system of the synergetic system, which prepares it for the opportunity to jump to the solution of individual problems.

-Development of individual issues corresponding to the initial (general) issues. The solution of individual problems should be based on the solution of general problems. At the same time, individual issues should have different levels of difficulty for the task of personal development of students. Only in this case does the principle of nonlinearity ensure the transition to a new level.

-Develop individual issues that require the application of experience in solving common problems in changed or new conditions.

The construction of the specified system is used for different types of issues. The following types of problems are based on the ways in which students use them to solve problems:

A) An issue related to the analyzed algorithm and the finished program.

C) an issue related to a partially described algorithm and a space program.

C) an issue similar to that of the analyzed algorithm and the finished program.

D) an issue that requires the application of a standardized approach but does not analyze the analogy.

A non-standard issue, an issue of increased difficulty.

For general problems, it is necessary to develop type A problems (problems with the analyzed algorithm and the finished program). A type C problem (a problem similar to the analyzed algorithm and ready-made software problem) and a type D problem (a problem that requires the application of a standard approach but does not analyze a similar problem) are developed individually. The amount of

individual options depends on the number of students in the group and their level of personal preparation.

A type V problem (a problem involving a partially described algorithm and space programs) is developed if the level of preparation of the students is low or the topic is complex enough and poorly mastered by the students.

Type E topics are designed for students with a high level of preparation.

CONCLUSION

The proposed methodology for constructing a system of problems proposed to teach higher education students programming is weakly linked to a clear programming language. Since program texts (full or blank) only encounter type A and B issues, it is sufficient to replace them when using different programming languages. For type A or B problems, the problem-solving steps described remain unchanged.

It allows to recommend for introduction to the educational process today through the formation of algorithmic competence based on the application of a system-task approach in teaching students of higher education institutions.

Modern textbooks and manuals published today require that students focus on the use of a system-based approach in teaching algorithms and programming.

This approach has also been used in the development of practice-oriented tasks to check and assess the quality of students' knowledge of current and intermediate and final controls in higher education institutions in the process of fractal, individual or group work.

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