

Theoretical Justification for The Development of a Methodology Aimed at Developing the Algorithmic Competence of Teachers in The Process of Differential Teaching in Mathematics

Akhmedova Nilufar Mamasidikovna¹

¹Department of Primary Education, Faculty of Primary Education, Kokand State Pedagogical Institute.

*Corresponding author's E-mail: ahmedovanilufar72@gmail.ru

Article History	Abstract
Received: 08 June 2023 Revised: 21 Sept 2023 Accepted: 10 Dec 2023	<p><i>This article is devoted to research on the formation of algorithmic competence of teachers in the process of differential teaching in mathematics. The study is based on the theoretical views of outstanding scientists in the field of pedagogy. The key point in this article is the formation of algorithmic competence of students with the help of algorithmic thinking and with an algorithmic culture. As a result, organizational and pedagogical conditions for the formation of algorithmic competence of students of higher educational institutions have been developed.</i></p> <p>Keywords: Competence, Intellectual Development, Differentiated Learning, Critical Understanding of Information, Data Visualization, Structuring, Algorithmic Thinking, Algorithmic Culture</p>
CC License CC-BY-NC-SA 4.0	

1. Introduction

As a result of the introduction of differential teaching in mathematics, widespread changes are taking place in the system of developing teachers' competencies. Solving computational problems, which is the main form of educational activity in the study of science and mathematics subjects, becomes one of the effective ways of intellectual development and the formation of algorithmic competence of teachers. This training is aimed at developing logical-algorithmic thinking, acquiring skills and abilities in algorithmic activities. The ability to compose algorithms is becoming an important element in the process of solving computational problems, and in the conditions of modern forms of differentiated learning, this skill is of key importance. Modern trends in technologization and practical content of education in the field of mathematics are characterized by a shift in emphasis from the study of the basics of algorithmization to the training of primary school teachers and require the development of appropriate content, structure. And didactic conditions for the formation of skills to integrate these skills into the education of the younger generation at the early stages. One of the key areas in modern developmental education is individualization, which is based on a differentiated approach to learning.

Literature Review

Within the framework of this study, it is proposed to separate the concepts of "competence" and "competence". Taking into account the point of view of I.A. Zimnaya, who argues that "competence" is a broader concept than "competence": competence in the process of development is integrated with other competencies, enriched by personal experience in practical activities, understanding the aspects of this activity, taking responsibility for the result, the need for self-development, thereby "develops" into competence. Our analysis of the scientific literature showed that the problem of developing algorithmic competence of students in the learning process attracted the attention of many didactics, psychologists, and practical teachers and was considered during the study of individual subjects (Yu.K. Babansky, N.M. Bibik, L.V. Lerner, V.F. Palamarchuk, M.M. Skatkin, etc.), in the context of improving the process of teaching mathematics by means of algorithmization (M.I. Burda, V.M. Monakhov, M.. Lapchik, A.A. Stolyar, I O. F. Teslenko, L. Chervochkina, etc.), as a component of cultural information (S. O. Beshenkov, A. F. Verlan, M. I. Zhaldak, O. A. Kuznetsov, Yu. I. Mashbits, Yu. A. Pervin et al.), the use of ICT (S.O. Beshenkov V.Yu. Bykov M.I. Zhaldak, Yu.A. Doroshenko, A.. V.A. Ershov, O.A. Kuznetsov, V. L.V. Lapinsky, L.G. Luchko, Yu.I. Mashbits, V.M. Monakhov, N.V. Morse, Yu.A. Pervin, I.F. Teslenko, etc.), in the process of solving problems with using

programming systems (M.I. Zhaldak, V.M. Monakhov, N.V. Morse, Yu.S. Ramsky, V.D. Rudenko, etc.), the use of algorithmic tasks of different levels of complexity to manage educational and cognitive activities students (D.M. Bogoyavlensky, Yu. Galperin, S.Yu. Goncharenko, V.V. Davydov, E.M. Kabanova-Meller, L.N. Landa, O.M. Leontyev, Yu.I. Mashbits, Yu.S. Melnik, N.O. Menchinskaya, O.N. Rodionova, O.Yu. Savchenko, N.F. Talyzina, D.B. Elkonin and others).

2. Materials And Methods

As a result of the formation of new systems of differentiated training, information and communication technologies (ICT) are being widely introduced into all spheres of human life, which requires appropriate qualifications of performers. This poses the task of modern school education to form a harmoniously developed, creative personality, capable of active self-realization and self-development already at the stage of primary education. A prominent place in this process belongs to the development of the intellectual abilities of primary school teachers, their logical and algorithmic thinking, which actualizes the issue of their preparation for the formation of algorithmic competence. Differentiation of education is aimed at creating equal initial conditions and opportunities for the development of each student, taking into account his inclinations, individual inclinations and abilities through the inclusion of various groups in the activities. Solving computational problems as the main form of educational activity in the study of subjects of the natural and mathematical cycle is one of the ways and an effective means of intellectual development and formation of algorithmic competence of primary school teachers. As it is aimed at developing logical-algorithmic thinking, acquiring the skills and abilities of algorithmic activity necessary to implement the concept of differentiated learning in the information space.

A competent specialist, according to the position of Yu. G. Tatura must: perform his professional functions efficiently, effectively solve professional problems in the absence of ready-made solution algorithms, adapt to changing working conditions, develop professionally in his chosen profession and be able to work with a team. Modern mathematics teachers actively implement and use all technologies proposed and developed within the framework of differentiated learning. According to the current mathematics program, the formation of algorithmic competence of students involves: Ability to: structure data; act according to the algorithm and draw up an algorithm; determine the sufficiency of data to solve the problem; use different sign systems; find information and evaluate its reliability; prove the truth of statements; Installation: critical understanding of information and sources of its receipt; awareness of the importance of ICT for making effective decisions; Learning resources: data visualization graphs and charts. In our research, we attach special importance to developing data structuring skills when studying mathematics. Important concepts in characterizing algorithmic competence are the concepts of “algorithmic thinking” and “algorithmic culture.” In scientific and methodological literature, the basis of algorithmic thinking is the ability to design algorithms. Algorithmic thinking is understood as a system of mental modes of action, techniques, methods and corresponding thinking strategies that are aimed at solving both theoretical and practical problems and the result of which are algorithms as specific products of human activity.

The formation of algorithmic thinking is closely related to the formation of a general ability to solve problems. Because in order to determine a general way to solve a class of problems in the form of an algorithm, it is necessary to first find a general method, and then explore the possibility of describing this method in the form of constructive, clearly understandable sequential steps. The basis of algorithmic competence is algorithmic culture. Most scientists interpret the concept of algorithmic culture as a complex of personal qualities and a certain level of algorithmic thinking, which provide:

- 1) understanding of the role of algorithms in various types of activities;
- 2) the ability to act according to a given algorithm in expanded or collapsed form);
- 3) the ability to make choices and apply algorithms in their activities;
- 4) ability to design algorithms;
- 5) the ability to describe a method for solving problems in the form of an algorithmic task. The difference between creating algorithms in programming and in algebra is that in programming, program flowcharts are used more graphically, while in algebra, pseudo-rhythmic instructions are used verbally). According to A.A. Stolyar, teaching mathematics is a didactically appropriate (reasonable) combination of teaching mathematical knowledge and cognitive activity to acquire this knowledge. Using cross-curricular connections between computer science and mathematics, it is advisable for a mathematics teacher to show students how basic programming commands can be successfully used in algebra lessons. So, examples of using linear commands are: reducing terms of

the same type, multiplying monomials, solving linear equations, plotting functions, etc. The branch command is used when expanding parentheses, quadratic equations, that is, in those examples where it is necessary to check a certain condition while executing a task. The repeat command can be used, for example, in the following problem: Find the first five terms of the sequence:

$$a_n = (n+1)/2n.$$

Therefore, in order to correctly form algorithmic thinking, it is necessary to familiarize students with the composition of elementary algorithms. Taking into account the psychological characteristics of future primary school teachers and their interest in something unusual at the beginning of studying algebra, it is advisable to show students what a flowchart looks like, to show how to present the process of solving a problem in the form of flowcharts. Experience shows that schoolchildren like to present algorithmic instructions in the form of flowcharts and vice versa. A background note written by the students with the help of the teacher is important.

Branching: Repeating:

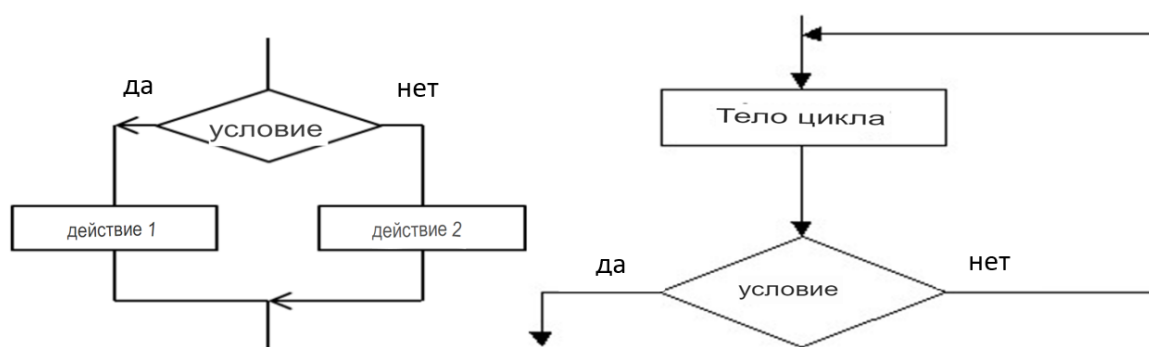


Figure 1: Types of block diagrams.

Flowchart language is the most visual of all human languages used to write algorithms. This language can be used to describe various physical, chemical and technological processes. The ability to present one's reasoning in the form of a flow chart significantly disciplines students' thinking and becomes an indispensable practical quality of a specialist in any profession. If you teach students how to make flowcharts, they will be able to create text-based algorithms for solving problems much faster and more efficiently. At the beginning of getting acquainted with flowcharts, you should ask students to describe life processes and activities at school in the form of flowcharts. For example, these could be the following tasks: make a flowchart for algorithms:

1. If a student has not studied his homework, he will receive a low score; if he has studied, he will receive a high score.
2. When completing test tasks, you need to check the completed task; if there are no errors, move on to the next one.
3. The loader fills the car with boards.

Once students have learned to translate regular language into flowcharts, they should be encouraged to create flowcharts to solve math problems. Early flowcharts can be easy to create if students understand the thinking and remember the sequence of steps. Clarity in flowcharts is a means of preventing common student mistakes. For example, when opening parentheses preceded by a minus sign, students have been known to forget to change the term signs into the opposite parentheses. To prevent such mistakes, students should be tasked with creating a flowchart on their own. The practical significance of using flowcharts or algorithmic instructions in accordance with the theory of step-by-step formation of mental actions. According to Ya. Galperin, the process of forming new actions proceeds more easily, without memorizing new material, since it is acquired in the process of executing the algorithm through spontaneous memorization. A flowchart for solving a quadratic equation by students might look like this:

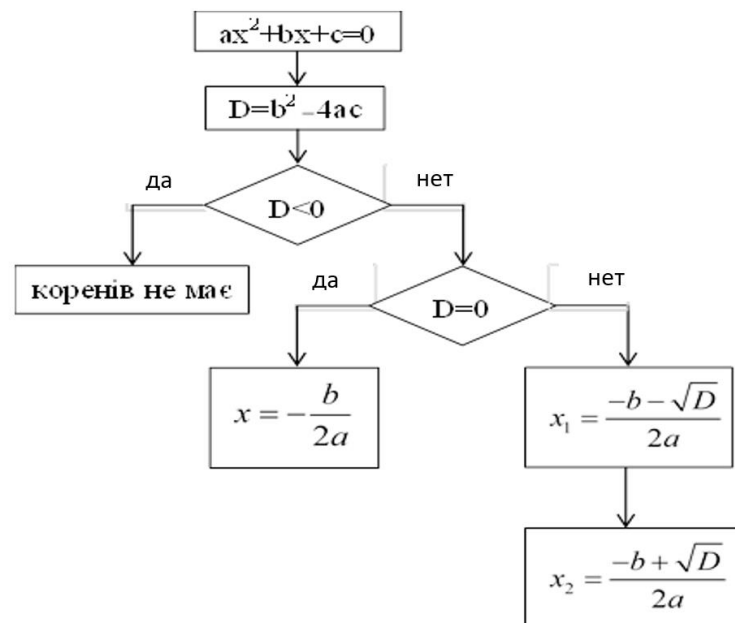


Figure 2: Flowchart for solving a quadratic equation.

Quite often, as a result of a false association, students confuse the methods of solving quadratic equations and quadratic inequalities. In order to avoid mistakes when solving quadratic inequalities, it is advisable, together with students, to create an algorithmic task for solving such inequalities and present it graphically in the form of a block diagram. The next step is to compare schemes for solving quadratic equations and quadratic inequalities. Obviously they are different. Students will remember this fact, and in the future solving quadratic inequalities will not be reduced to solving quadratic equations. It is advisable to include instructions in the algorithm that encourage students to control their actions. This helps prevent common mistakes. Control actions are repeated repeatedly, and therefore, gradually collapsing, they become a necessary component of the formed generalized association. Over time, having developed an algorithm for performing actions, you can gradually “collapse” it, since the educational material will be correctly learned, and if necessary, students will be able to “expand” it when needed.

The ability of students to algorithmize their actions and think in algorithmic categories is an important means of preventing mistakes both when studying a topic and in the future. To teach students to create algorithms, read algorithms and perform actions on the algorithm they have created, the teacher himself must have such skills. Further research is needed into the methodology for developing the algorithmic competence of a future mathematics teacher within the walls of a pedagogical university. The formation of algorithmic competence in the context of the targeted intellectual development of primary school teachers is characterized by the level of development of logical-algorithmic thinking of the individual. Ensures that students understand the general methods of algorithmization, the algorithmic essence and the ability to automate the practical sphere of human activity, the ability to organize algorithmic activity in the process of solving various problems. The formation of logical-algorithmic thinking in mathematics contains a set of knowledge, skills and abilities for working with algorithms; it is formed in the process of studying almost all school subjects, since such methods of mental work as planning one’s own activities and finding rational ways to carry them out are systematically and consistently formed. In order to identify and theoretically substantiate the didactic conditions for the effective formation of the algorithmic competence of primary school teachers into the exact structure of the personality. The formation of algorithmic competence (AC) of primary school teachers is a complex dynamic process that requires an integral multicomponent system of teacher work, where it is necessary to take into account each component included in the structure of AC. The didactic conditions for the formation of algorithmic competence are understood as specially created circumstances of the learning process, which are the result of systematic selection, design, application of content elements, forms, methods and teaching aids that will make the process successful.

3. Results and Discussion

According to the results of the analytical and exploratory research, the didactic conditions for the effective formation of algorithmic competence of future primary school teachers in the process of solving computational problems are:

- ✓ creation of positive motivation for educational and cognitive activities aimed at the formation of algorithmic thinking in the process of differentiated learning;
- ✓ didactic construction of training content aimed at teaching solving computational problems;
- ✓ implementation of the educational process based on the selection of a didactically sound system of computational tasks aimed at developing algorithmic skills;
- ✓ introduction of innovative teaching technologies into the educational process;
- ✓ implementation of interdisciplinary connections between computer science and subjects of the natural and mathematical cycle;
- ✓ practical orientation of the content of education and increasing the share of independent educational and cognitive activities of students;
- ✓ providing feedback and developing the ability to reflect.

Organizational and pedagogical conditions for the formation of algorithmic competence of students of higher educational institutions have been developed:

- ✓ optimization of the educational space of the university, ensuring the formation of positive motivation among undergraduates to master algorithmic competencies;
- ✓ modeling by students of future teaching activities, rich in the use of the structure of teaching aids;
- ✓ development of future teachers' skills in working with modern teaching aids.

The identified didactic conditions are logically connected and interdependent, and each of them is necessary for the effective formation of algorithmic competence of primary school teachers. The absence or replacement of one of the conditions makes it impossible to successfully develop the algorithmic competence of primary school teachers in the process of solving computational problems in the conditions of differentiated learning.

4. Conclusion

The basis for choosing the system was a mathematical structure. When selecting a system of subject problems related in mathematical content, for the solution of which specific mathematical methods should be used, we adhered to certain general methodological requirements and principles: scientific character, accessibility, consistency and consistency, differentiated feasibility, continuity. Introduction of innovative technologies into the educational process. In the process of developing the algorithmic competence of primary school teachers in the process of solving computational problems, we used active learning methods that intensify the learning process (problem task, discussion, brainstorming); orientation towards the development of student independence as a subject of educational and cognitive activity (independent work, laboratory work). And combine the process of acquiring knowledge and solving practical problems (modeling method, computer experiment, search methods, etc.).

Implementation of interdisciplinary connections between the theory of algorithms and subjects of the natural and mathematical cycle.

Numerous studies indicate the significant impact of teaching the theory of algorithms on the development of students' logical and algorithmic thinking aimed at finding solutions to subject problems. Solving problems in the natural and mathematical cycle using the theory of algorithms, modeling real situations and objects, processing experimental results, etc.) raises the interdisciplinary nature of the theory of algorithms to a higher level in relation to other possible interdisciplinary connections in the process of teaching school subjects and shows its universal nature algorithmic competence.

Practical orientation of the content of education and increasing the share of independent educational and cognitive activities of students.

A gradual increase in the share of students' independence in solving problems allows the student to choose the pace of work in accordance with individual characteristics and level of training, which contributes to individualization, differentiation and humanization of the educational process. And also develops in students the ability to independently plan their own educational activities, look for rational ways to carry them out (independently analyze the capabilities of available means to complete the task, build algorithms for solving the problem, critically evaluate the results obtained), which contributes to the formation of algorithmic competence of primary school teachers.

Implementing feedback and developing the ability to reflect in future teachers.

A person's ability to reflect is characterized by his readiness to understand his inner world and the world of another person. It is reflective activity that allows the student to control and evaluate his own level of AC formation. The value of reflection from the point of view of developing the algorithmic competence of primary school teachers is that it helps students to analyze and plan their own activities accordingly

References:

1. Еркибаева Г.Г. Место и роль дифференцированного обучения в обеспечении специализации учебного процесса для различных групп обучаемых // Международный журнал экспериментального образования». – М.: Москва, 2015. – № 1. – С. 8-12
2. Смаглий Т.И., Утегенова Б.М. Основы дифференциации преподавания и обучения в современной школе: учебно-методическое пособие. – Астана: АОО «Назарбаев Интеллектуальные школы» Центр педагогического мастерства, 2016. – 99 с.
3. Столяр А.А. Педагогика математики / А.А. Столяр. – Минск. Высшая школа, 1986. – 414 с.
4. Зимняя И.А. Ключевые компетенции – новая парадигма результата образования / И.А. Зимняя // Высшее образование сегодня. – 2003. – №5. – С. 34-42.