УДК 373.1.02:372.8 DOI: https://doi.org/10.24195/2617-6688-2021-2-1

Forms of applıcatıon of algorıthms ın school mathematıcs teachıng

Kamala Gaybaliyeva Yunis [1]
Ganja State University, Ganja, Azerbaijan
E-mail: rahimr0909@gmail.com
ORCID ID https://orcid.org/0000-0001-8336-1773

As for the qualitative definition of the theoretical structure of the concept of algorithm, obtained by building a system of its study on the basis of component analysis in the article, it should be completed by studying the types of algorithmic processes. Three common types of such processes (linear, branching and recursive) play a slightly different role here. The first two types are somewhat simple, as we tried to show in Example 1, it would be natural to use them in the study of the components of the algorithm. Recursive processes can be applied to the play of already separated concepts. There are plenty of examples in various sections of Algebra, such as the "sequences" section, in particular. Finding the approximate value of an expression using the Heron formula can be a good example of recursive processes. The purpose of the research is to develop a methodological system that identifies opportunities to improve the quality of integrated mathematics teaching in V-IX grades and connect it with computer technology as well as identifies ways to apply it in the learning process.

Textbooks often show the performance of a particular action on a few specific examples. We come across different situations here. Sometimes the rule is stated after the solution of the work, and sometimes the work is considered after the expression of the rule. The third case is possible, there is no definition of the rule in the textbook, but specific examples of the application of the formed algorithm are considered. This is quite common in school textbooks, especially when considering complex algorithms. In such cases, it is accepted to call the solutions of the studies as examples. The sample solution must meet certain requirements. Let's separate some of them from the point of view of the formed algorithm: the most characteristic cases of the considered type of problem should be considered; numerical data should be selected in such a way that the necessary calculations can be performed orally in order to draw students' attention to the sequence of elementary operations that make up the steps of the formed algorithm. If the problem-solving example meets these requirements, then the type of problem assigned to it can be considered as an algorithm for solving the problem. If, depending on the initial data, there are several fundamentally different cases of problem solving, it is necessary to consider examples of problem solving for each such case.

Keywords: *algorithmic culture, algorithmic descriptive languages, block diagrams, equations, tables, algebra textbooks*

Introduction. None of the modern Algebra classes we know has any of the features listed above that implement an algorithmic line. This is reflected in the characteristics of his condition in school algebra. An important concept of the algorithmic line is the algorithm, which is separated at the end of the course and is essentially alone (block diagrams perform only the function of illustration, ideas about the program and algorithmic language are given in the introductory plan). The concept of algorithm does not last long as a subject of study. It is mainly used as a term that combines several synonyms: rule, sequence of actions, etc. The most characteristic feature of the algorithmic line is the pre-deduction of the algorithm, which is carried out through the organisation of the study of materials of another line.

Formulation of the problem. Most of the content-methodological lines presented for methodical research of school algebraic materials correspond to each other in a number of relations. The most important of the common features is the early separation of the concept (or group of concepts) in each line and the duration of its development in the course as a subject of study; formation of a system of concepts that reveals the content of this line; establishing multifaceted relationships within this system.

Other lines, such as the application line, have similar characteristics. The fact that this line belongs to one of the two groups described here is of particular importance for the application of methodological problems related to this line. Considering that they include traditionally, methodologically deeply studied materials, let us call the first group of lines classic and the second one modern.

It should be noted that the fact that the lines belong to one of these groups is its relative characteristic. It depends on a number of reasons, in particular the timing of the creation of the analysed teaching aids and the nature of the implementation of the content of the line studied in them. For example, until the 1950s, the functional line could be considered modern due to the nature of its manifestation in the school algebra course. When it comes to the algorithmic line, we encounter a similar situation. Turning it into a classic line of Algebra can be a matter of the near future.

[1] *Senior Lecturer of the "General Mathematics" Department of Ganja State University, PhD student*

Latest research and analysis of publications: V. M. Monakhov, M. P. Lapchik, A. P. Yershov, N. F. Tamzina, A. S. Adigozalov, A. G. Palangov, R. Z. Humbataliyev and others from foreign researchers or directly related to our problem, i.e. the quality of Mathematics teaching using algorithm descriptions and conducted research to increase efficiency, or developed valuable scientific and methodological tools on computerisation and programming. They studied the application of computers and calculators in Mathematics teaching.

Research objectives:

1. Substantiate the need for regular application of descriptive tools of algorithms, which are the basis of computer programming, in the teaching of Mathematics in V-IX grades;
2. Research of dissertations, educational-methodical literature devoted to the application of algorithms in Mathematics teaching;
3. To study the school experience, to study the situation in terms of the application of the descriptive means of the algorithm in the teaching of Mathematics;
4. Determining the superiority of algorithms in the learning process over other descriptive means of block diagram description;
5. Development of technology for algorithmic construction of Mathematics teaching in V-IX grades;
6. Experimental testing of the established technology in secondary schools;

The methodological basis of the research is a set of methods, principles, tools and theoretical provisions applied in order to study, understand and change pedagogical facts, events and processes.

The main part. As for modern lines, the choice of material is a serious issue at the time of the formation of the content of these lines. According to the essence of the description of modern lines, "the appropriate material can be specific to the basic concept of such a line only at the end of the course.

2. The development of algorithmic theory was accompanied by a careful analysis of the nature of algorithms and their importance in mathematics. In the course of the research, several components of the concept of algorithm were separated: discreteness, deterministicity, efficiency, mass, finite certainty. As a result, two concepts emerged: substantive and formal, which are interrelated with Turing's thesis, which confirms their content equivalence. The use of the concept of algorithm is widespread in the didactic and methodological literature.

3. Methodologically important work is to conduct component analysis using the allocated components and to develop a system for studying the algorithmic line of the school Algebra course. Materials for organising the preparation for the concept of algorithm can be several calculation procedures. Consider a specific example (Studying the basics of computer science and computer technology, 1985:191).

Example 1. The method of addition of equations and its use for solving a system of two unknown linear equations. Let us describe the algorithm underlying this method. Let us denote it by A. Our goal is to distribute this description over the components of the concept of algorithm and to show the possibilities of using such a description in the study of the method considered in the school algebra course. The discreteness of the algorithm assumes that A is divided into a finite number of elementary procedures (operators).

Each operator is considered an indivisible operation in the description of the given algorithm.

$$\{\alpha_1 x + \alpha_2 y = \alpha_3$$
$$\{b_1 x + b_2 y = b_3$$

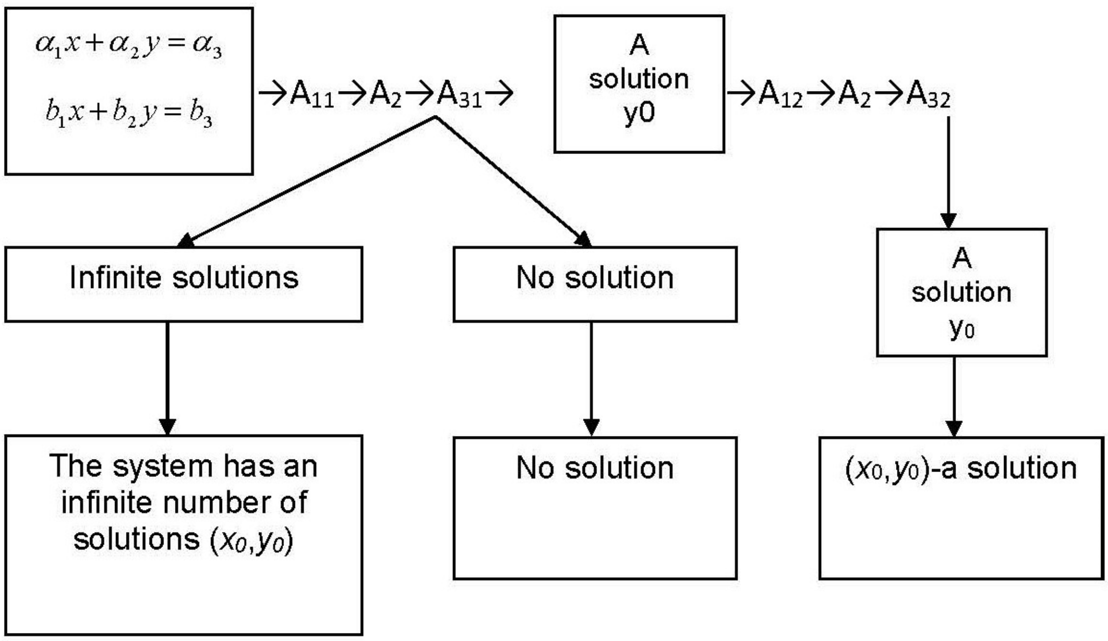
Let us show the list of operators.

Addition of A_2 equations and reduction of the obtained equation to an unknown linear equation.

Solution of linear equations A_{3k} ay = b (k = l) and ax = b (k = 2).

The operations on algorithm A are performed in several cycles. Each time is the execution of one of the operators A11, ..., A32 in the numbers indicated at the beginning of the execution of the time. The determinism of A means that the order of execution of the time determines the choice of the operator for the next time, depending on the result obtained from the previous one in completely logical terms. Algorithm A can be represented in the following scheme (block diagram): (Lapchik, 2001:624).

The effectiveness of Algorithm A is manifested in the fact that any system receives a response from a given class of finite number of cycles. It is obvious that A11, ... A32 implies the efficiency of each of the operators. The description of the set of incoming data and the forms of presentation of the answer is a necessary part of the algorithm. The description of the data is as follows: (a1, a2, a3, b1, b2, b3) - a sequence of numbers that enters the numerical domains known from the algebraic course and is written in the form adopted for these domains. In this case, the numbers a1, a2, b1, b2 are not equal to zero (Palangov, 2000:25).



The finite certainty is a condition for the description method of the algorithm. There should be no vague indications in the description, so that "and so on", "in a similar way" and so on should not be allowed in our speech to clarify them.

From the shown effect of algorithm A, taking into account some of the methods of studying the description of a system of linear equations with this algorithm.

Discretion. At the beginning of the study of the addition method, the importance of the operators used in this algorithm should be indicated.

Determining is necessary to clarify the role of each of the operators in the process of studying the topic, i. e. the logic of the algorithm. It is necessary to consider different ways of transition of the block diagram of the algorithm on examples. This work leads to the following types of tasks:

A_{11} - A_2 - A_{31} - an infinite number of solutions
A_{11} - A_2 - A_{31} – no solution
A_{11} - A_2 - A_{31} - A_{12} - A_2 - A_{32} a solution.

Efficiency. It manifests itself when studying the effect of initial data on the response.

Mass. The coefficients of the equations can be divided into several examples when they enter different numerical domains. In this case, in the solution process, it is necessary to draw students' attention to the uniformity of steps (tactics of algorithms).

Inability to be finite. This component manifests itself in the course of a brief final description of the studied solution method of a system of linear equations.

The training can cover one of two aspects in the methodology for detecting the components of Algorithm A: the study of specific procedures or the gradual formation of ideas about the general features of all such procedures (Demidovich, 1976: 46-51).

Algorithmic lines. The relevance of Algebra to modern lines and the need to use them in this regard place some limitations on the nature and development of algorithmic ideas in the study of non-specific material for much of the course.

Once again, it is clear that, as a rule, the same operation is performed in several ways.

Example 2. Special cases of solutions of systems of linear equations. Let's solve the system of equations;

A){$-7x+2y=3$ b){$7x+2y=3$ ç) {$2y=5$
{$12x+4y=8$ {$7-4y=-1$ {$3x+3y=7$

a) It is convenient to start the solution of the system not with the help of algorithm A, but with the method based on it. In this case, it is enough to take the numbers 2 and 1 to remove y as an additional multiplication. b) The first variable can be eliminated to solve the system, in which case the subtraction of the equations can be used instead of the addition of the equations. c) The system does not belong to the domain of algorithm A, because then a1 = 0. The substitution method is used to solve it (Kabanova-Meller, 1986:288).

It should be noited that the reason for the introduction of constraints on the coefficients of the system in algorithm A is the desire to simplify its structure. In principle, in a special case, as discussed in Example 2, it complicates the given algorithm. It can also be combined with the Gaussian method and an algorithm that implements the method of substitution of the solution of a system of linear equations. However, it is as difficult as it seems to be "algorithmically" consistent in a school algebra course. This algorithm cannot be significantly expanded without complicating its structure (Algebra: Trial textbook for the 6th grade of secondary school, 1985:206).

From the above, it can be concluded that algorithms with a specific method should be used not in isolation in the Algebra course, but in the context of certain topics with other methods (although many of the methods in such blocks are algorithmic in nature, only some of them have algorithmic extensions.

For example, the line of equations and inequalities can be described by the algorithmic extension to describe the general features of the solution of several classes of equations written in a certain "canonical" form. The concept of an algorithm is not enough to describe the process of bringing it to such a canonical form. Another mathematical concept (calculation concept) is used here.

The difference between an algorithm and a calculation that is important in a given case is that an algorithm is a system of commands that oblige you to perform a certain action when certain conditions are met, and a calculation is a system of permissions for such use. An example of a calculation can be a system of properties of the name of arithmetic operations when applied to issues related to the transformation of expressions. In such tasks, the answer is not always predetermined, and if the answer is one-sided, it may be a non-one-sided solution (Zinchenko, 1997:3-16).

However, if the task of simplification is to bring it to a canonical form, the uncertainty of the answer disappears. Therefore, operators can be used to write algorithms in the form of "bring the expression (equation) to the canonical form." Algorithms used by such operators in algebra textbooks already appear in the solution of one-degree equations. For example, in the textbook (Adigozalov, 1996), the following description of the process of solving such equations is given: “for this; 1) move the variable input limits to the left and the variable input limits to the right. 2) To correct similar limits, it is necessary to divide both sides of the equation by the product if the coefficient is different from zero. In this description, two types of operators are distinguished: operators that bring the normal form (transfer of limits from one side to the other; explanation of similar limits) and operations with the normal form (division of both sides of the equation by the coefficient of the unknown). Thus, this algorithm is the simplest type of linear binary construction.

It can be assumed that it is expedient to start the activity on separation of the components of the concept of algorithm on the example of simple processes of algorithmic nature (Kastornov, 1978:23).

Let's go back to Example 1 and note that the method used in Algorithm A has an independent content. Its field of application is slightly wider than the two-variable linear system. Obviously, the addition method (as well as the substitution method) must be distinguished from any of the algorithms in which these methods are used. For example, the system (*) is easily solved outside the relationship with the theory of systems of three-variable linear equations by the method of addition.

$$\left\{\begin{array}{l} x+y=1 \\ x+p=1 \\ y+p=1 \end{array}\right\|\right\}$$

It is not considered in school Algebra. The scope of application of the operators of a particular algorithm is the transfer, which is a psychological phenomenon in situations where the application of a more extensive method than the first algorithm. The peculiarity of the use of transfer, which is applied to the expansion of the content of the algorithmic line of algebra, is that it can be carried out in a situation that is fully understood by students. The separation of the addition method from the algorithm can be organised as follows: when considering a finite component, it should be noted that the importance of the operator A2 is to reduce the number of variables in the obtained equation compared to a given system, then to solve a system of equations algorithm should be used outside of algorithm A, and the addition of equations should be recorded as an independent procedure. The transfer takes on a logical rationale for the propositions: the sum of the equations is the logical result of the given system (Adigozalov, 1996:100-105).

As the habits of applying algorithms are formed, the activity on its implementation expands. This means that students gain the ability to imagine the algorithm as potentially fulfilled without actually implementing it.

An extended algorithm can be used as an operator in another particular algorithm; for example, A_{31} and A_{32} are broad algorithms for solving linear equations with one variable (Hamidov, 1999:25).

Approbation of research results. The main provisions of the article are reflected in the author's theses submitted to scientific conferences in Azerbaijan and abroad, as well as in scientific articles published in various journals in Azerbaijan and abroad.

Conclusion. We come to the conclusion as follows: the algorithmic line of school Algebra can be realised through the obscure formation of the concept of algorithm on traditional procedural materials of algorithmic type. This material is used to formulate the components of the algorithm concept by considering the specific receptions of the operating blocks.

These receptions include:

- the study of two-dimensional algorithms, including the conversion of the canonical image (1) and the subsequent transformations of the canonical image (2);
- inclusion of the algorithm in the operating block;
- the use of a transfer with a wider field of application to separate it from the main method of the algorithm;
- sequential transformations that allow the use of algorithms as operators in more complex algorithms.

The use of the proposed methods of studying the operating blocks in the system of expansion of algorithmic ideas can be considered as the basis for the inclusion of the algorithmic line in school algebraic materials.

However, in addition to these systems, there are many motivations for preparation for this course and for clarifying the content of the algorithm concept.

4. Finally, let us focus on the issues of further expansion of the content of the algorithmic line. Such an extension provides an idea of both the theoretical structure of the concept of algorithm and the style of its use in applications.

The fact that this concept is reflected in the school Mathematics course significantly strengthens the direction of application of the course. Thus, it plays a crucial role in the theoretical understanding of the use of modern computer technology.

As for the qualitative definition of the theoretical structure of the concept of algorithm, obtained by building a system of its study on the basis of component analysis, it should be completed by studying the types of algorithmic processes. Three common types of such processes (linear, branching and recursive) play a slightly different role here. The first two types are somewhat simple, as we tried to show in Example 1, it would be natural to use them in the study of the components of the algorithm. Recursive processes can be applied to the play of already separated concepts. There are enough examples in various sections of Algebra, for example, in the section "Sequences", in particular, finding the approximate value of the expression $\sqrt{a}$ with the help of the Heron formula can be a good example of recursive processes (Demidovich, 1976: 41-56).

The basis of the application of the algorithmic line is the creation of ideas about the programming of computational processes. It should be noted that the ideas of the implementation of the algorithmic line have a wide range of applications in the materials of the main course of school Algebra. In particular, the study of a number of problems of school algebra with the help of a programmed microcomputer creates opportunities to increase the role of calculations (Studying the basics of informatics and computer technology in the secondary school: experience and prospects, 1987:192).

References

Adigozalov, A.S, & Tagiyeva, S.C. (1996). Algorithmic approach in mathematics teaching as a means of improving the quality of mastering. *Issues of improving mathematics teaching in higher pedagogical and secondary schools*. Baku., ADPU, pp, 100-105 [in English].

Algebra: Trial textbook for the 6th grade of secondary school (1985). Ed. Sh.A.Alimov, Yu.M. Kolyagin, MIShabunin; under the supervision of A.N. Tikhonov. M.: Education.

Demidovich, N.B, & Monakhov, V.M. (1976). Calculation algorithms. *Mathematics at school.* Vols., 4, pp. 46-51 [in English].

Hamidov, S.S. (1999). Methods of teaching computers to students of higher pedagogical schools: *Extended abstract of candidate's thesis.* Baku.

Kabanova-Meller, E.N. (1986). *Formation of methods of mental activity and mental development of students.* Moscow: Education [in English].

Kastornov, A.F. (1978). *Study assignments for students on the use of block - diagrams in the course of*

6 grades of algebra: Scientific Research Institute of SMO APN USSR.

Lapchik, M.P. (2001). *Methods of teaching informatics: textbook for students*. Ped. Universities Ed. M.P. Lapchik, I.G. Semakin, E.K. Henner; under the general ed. M.P. Lapchik. M. Ed. Center Academy [in English].

Palangov, AG. (2000). *Computer usage rules* (Windows-98). Baku, ADPU

Studying the basics of computer science and computer technology. (1985). Method. manual for teachers and teachers of environments. study. institutions. 2 v, Part 1. / A.P. Ershov, V.M. Monakhov, A.A. Kuznetsov and others; Ed. A.P. Ershova, V.M. Monakhova. M.: Education.

Studying the basics of informatics and computer technology in the secondary school: experience and prospects (1987). Comp. VM Monakhov and others. Education. Moscow.

Zinchenko, V.P. (1997). Goals and values of education/ *Pedagogy*, M, Vols. 5, pp. 3-16.

Форми застосування алгоритмів у шкільному навчанні математики

Камала Юніс Гізі Гайбалієва[2]

Гянджський державний університет, Гянджа, Азербайджан

Окреслено якісне визначення теоретичної структури поняття алгоритму, отриманого шляхом побудови системи його вивчення на основі компонентного аналізу в статті, доведено, що його необхідно доповнити вивченням типів алгоритмічних процесів. Три поширені типи таких процесів (лінійний, розгалужений та рекурсивний) тут відіграють дещо іншу роль. Перші два типи прості, як намагалися продемонструвати на прикладі 1, природно було б використовувати їх при вивченні компонентів алгоритму. Рекурсивні процеси можна застосувати до гри вже відокремлених понять. Є безліч прикладів у різних розділах алгебри, таких як розділ "послідовності", зокрема, знаходження приблизного значення виразу за допомогою формули Герона може бути прикладом рекурсивних процесів. Метою дослідження є розробка методологічної системи, яка визначає можливості підвищення якості інтегрованого викладання математики у V-IX класах та пов'язує його з комп'ютерними технологіями та визначає шляхи її застосування в процесі навчання.

Підручники часто показують виконання певної дії на кількох конкретних прикладах. Іноді правило викладається після розв'язання твору, а іноді твір розглядається після вираження правила. Третій випадок можливий, у підручнику немає визначення правила, але розглядаються конкретні приклади застосування сформованого алгоритму. Це досить часто зустрічається у шкільних підручниках, особливо при розгляді складних алгоритмів. Тоді прийнято називати рішення досліджень прикладами. Зразок розчину повинен відповідати певним вимогам. Виділимо деякі з них з точки зору сформованого алгоритму: слід розглянути найбільш характерні випадки розглянутого типу задач; числові дані слід добирати так, щоб необхідні обчислення могли виконуватися усно, щоб привернути увагу учнів до послідовності елементарних операцій, що складають етапи сформованого алгоритму. Якщо приклад вирішення проблеми відповідає цим вимогам, то тип задачі, яку йому призначено, можна розглядати як алгоритм вирішення проблеми. Якщо, залежно від вихідних даних, існує кілька принципово різних випадків вирішення проблем, необхідно розглянути приклади вирішення проблем для кожного такого випадку.

Ключові слова: *алгоритмічна культура, алгоритмічні мови опису, блок-схеми, рівняння, таблиці, підручники з алгебри*

Accepted: May 12, 2021

[2] *старший викладач кафедри "Загальної математики" Гянджського державного університету, аспірант*