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Interdisciplinarity of Mathematics in Primary Education

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ABSTRACT

The purpose of joint lessons of mathematics and school subjects of the natural sciences and the humanities is to construct a space for interdisciplinary dialogue, in which the language of mathematical models is given key importance in elementary school. As a result of the combination of the traditions of fundamental mathematical education and modern teaching technologies, a holistic thinking of the participants in the educational process is formed and mechanisms for the interaction of different languages and approaches are developed.

The modern change in the system of school education, including primary education, is associated with the introduction of the State Educational Standard of the Republic of Uzbekistan of primary general education [1], in which the achievement of personal and metasubject results is considered along with subject ones. We believe that it is possible to achieve such results on computational content only in the paradigm of computational culture, considered from the point of view of an interdisciplinary approach.

Firstly, for a full-fledged analysis of the concept of "computational culture of younger students" it is necessary to involve different disciplines: cultural studies, mathematics, psychology, didactics, methods of teaching mathematics, metamethods.

Secondly, from our point of view, computing culture refers to the meta-subject results of primary education: it includes meta-subject concepts (number, dependency, magnitude, etc. are disclosed by us in [6]), is widely used and can be considered in the classroom and in extracurricular activities in elementary school (in subjects - the world around us, native language (see work [1]), music, technologies, literary reading, physical education) and in the basic school (in physics, chemistry, drawing, etc.). In this regard, the formation of a computing culture by younger students requires the involvement of various subjects and the establishment of interdisciplinary connections along with intra-subject ones.

Without dwelling here in detail on our understanding of the computational culture of younger students, we note that the main thing we consider students to understand the essence of concepts and their relationships, the ability to transfer to other situations, meaningful analysis and interpretation of the results.

The possibility of establishing intra-subject relationships also follows from the fact that the computational aspect can be distinguished in almost all the main content lines of the initial course of mathematics [2], such as: "Numbers", "Values", "Arithmetic operations", "Text problems", "Work with data". Even in the line “Spatial relations. Geometric figures" often cannot do without numerical characteristics to describe geometric shapes, their properties and relationships (the number of angles, intersection points, the ratio of the lengths of the sides etc.).

Quantitative features of the real world (along with spatial and structural ones) are one of the objects of modern mathematics. Their study is necessary for a person to better understand not only mathematics, but also the world. At present, the social significance of the ability to understand the meaning of the numerical characteristics of the phenomena of the surrounding reality, described in the media, has increased (unscrupulous politicians often mislead people by referring to numerical data, the meaning of which readers and listeners do not understand).

In modern primary education, we have identified a number of contradictions associated with teaching computing.

The first contradiction is between the modern world requirements for the mathematical preparation of schoolchildren (research in the framework of the International PISA Program), the real-life connections of mathematics with other academic subjects, with life, on the one hand, and the insufficient implementation of interdisciplinary connections in teaching mathematics to younger students, their inability to apply their knowledge and skills in simple situations that go beyond the scope of narrowly educational ones, on the other hand.

The second contradiction is between the needs of society, the values of culture, on the one hand, and tradition, on the other:

- it is important to form a holistic picture of the world among schoolchildren, but at the same time, in school practice, little attention is paid to establishing various connections, without which integrity cannot be achieved;
- it is important to develop the personality, including its motivation, but this is not given due attention when teaching calculations (mainly external motives develop);
- it is important to teach to solve problems in uncertain situations, to form a research position [2], but little attention was paid to the inclusion of children in educational research activities on a computational basis;
- a younger student should become the subject of educational activity, but when performing calculations, he is more often in the position of an object of pedagogical influences;
- in the information society, a student needs to master information skills, school mathematical language, modeling, but in the practice of school work on computational content, until recently, this has not been given sufficient attention.

The third contradiction is between the fundamental meaning of the number line in the mathematics course in grades 1-11 and the fact that the study of number in elementary school does not lay the appropriate foundation. The line of the number is the leading line of both the initial course of mathematics and the course of grades 3-4.

P. A. Kompaniyts considered the idea of expanding the concept of number (from arithmetic) one of the main ideas of the school mathematics course, along with the ideas of measure and functional dependencies, and the establishment of relationships between them is a necessary condition for solving the problem of continuity in teaching mathematics. In addition, the concept of "number" is included in the list of fundamental concepts of the school course of the beginnings of mathematical analysis, along with the concepts of "function" and "continuity", which contain its main humanitarian potential and have a meta-subject character (since the ideas embedded in them concentrate a wide area of knowledge and are of great practical importance [5].

The fourth contradiction is between the fact that the computational culture of schoolchildren is of a meta-subject nature, and is formed in schoolchildren as a purely objective result of learning.

The fifth contradiction is between the fact that the initial and most important work of children with natural numbers and zero takes place in the primary grades, the school and society feel the need for "cultural calculators" to come to the 4th grade, and the fact that the question of computational culture younger schoolchildren in an explicit form was not set and did not dare. At the same time, the culture of computing with natural numbers and zero is the cornerstone of the general computing culture of schoolchildren [1].

As can be seen, the first, fourth, and partially second contradictions are associated with the lack of interdisciplinarity in teaching calculations, and the third with insufficient attention to intra-subject connections in the course of mathematics.

In the educational process, the interdisciplinary approach to teaching mathematics in the primary school can be conditionally divided into three relevant blocks: The first block includes the formulation of computational problems, when a mathematical model of some element of real life is built, which contributes to children's understanding of the origin of mathematical concepts, statements, computational problems. For example, assignments for the transition from subject and graphical models to symbolic ones, for compiling plot tasks based on the results of measurements or data collection, etc. The tasks of this block require modeling, recoding information, assessing the reality of numbers, and forecasting.

The second block involves working with a mathematical model. It includes the solution of actual computational problems and non-computational (qualitative) ones, which are aimed at comprehending and applying knowledge in various conditions, at establishing their meaningful relationships, at establishing the boundaries of the answer. In this block, much attention is paid to the assimilation of theoretical knowledge about arithmetic operations, the motivation for their introduction, the establishment of various relationships between them, and the use of calculations for rationalization [4]. Such work forces children to think about calculations, apply the theory they have learned, and please them with beautiful solutions.

The third block refers to the stage of interpreting the results of working with the model, associated with understanding the numbers obtained in solving problems, with their study [5]. Completing the tasks of the 3rd block allows children to realize the importance of calculations in mathematics, in other sciences, in life, to discover their personal meaning; develops elementary research skills, allows you to better understand the material being studied. Research and design activities with computational content, as a rule, go beyond the narrow scope of subjects, and allow schoolchildren to form a more correct idea of computational activity, and, using its example, of mathematical activity in general.

The above condition reflects such smaller interrelated conditions as:

- ✓ purposeful work to master the school mathematical language (its alphabet, syntax, and most importantly, semantics);
- ✓ targeted use of modeling - these are models of different types, transferring information from one type to another;
- ✓ establishing meaningful links between knowledge elements, establishing links with life (obtaining and interpreting models), with the student's subjective experience, intra-subject and inter-subject connections [7]; appeal to the history of mathematics, to the etymology of mathematical terms;
- ✓ the use of tasks of a variable, research nature.

Organizational and activity aspect.

- The use of independent work with the use of level and psycho-physiological differentiation (taking into account the peculiarities of perception and processing of information). This contributes to the understanding of the educational material, the success of its assimilation, which is an important motive for activity.
- Constant inclusion of children in creative activities based on computational material, including research and project activities (one reproductive activity extinguishes the need for creativity, interferes with the conscious assimilation of the material and reduces the desire to learn).
- Reasonable use of ICT for educational, cognitive and developmental purposes, together with traditional teaching methods [3].

In the process of computing activity, all three types of results specified in the State Educational Standards of the Republic of Uzbekistan are achieved. For example, such personal results as "a sense of pride in their homeland, the history of Uzbekistan"; “setting for a healthy lifestyle”, can be achieved through the plots of tasks and various types of encryption; information for verification of calculations; data collection, compilation and analysis of tables and diagrams, including those with personally significant content. "A holistic perception of the world around" - through the establishment of interdisciplinary connections with all subjects studied, including when children are included in research and project activities. Meta-subject results of “the ability to accept and maintain the goals and objectives of educational activity, to plan, control and evaluate one's actions” are formed if the computing activity is organized as a full-fledged educational activity; "the ability to use sign-symbolic means of representing information" - is formed when working with different types of models of numbers, computational techniques, tasks, equations. Familiarization of students with modeling allows them to see mathematics as a certain method of understanding the world.

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Most of the subject outcomes of teaching mathematics are directly related to computing culture: “the use acquired mathematical knowledge to describe and explain the surrounding objects, processes, phenomena, as well as to assess their quantitative relationships”; “mastering the basics of logical and algorithmic thinking, ... mathematical speech, the basics of counting, measuring, estimating the result and evaluating it, visualizing data in various forms (tables, diagrams, diagrams), recording and executing algorithms”; "the acquisition of initial experience in the application of mathematical knowledge to solve educational and cognitive and educational and practical problems"; “the ability to perform verbal and written arithmetic operations with numbers and numerical expressions, solve word problems, execute and build algorithms and strategies in the game, ... work with tables, diagrams, graphs and diagrams, chains, present, analyze and interpret data” [5]. Thus, the formation of the computational culture of younger schoolchildren ensures the achievement of personal, meta-subject, subject (mathematical) results of primary education [4] and contributes to the mathematical culture of students, which is being formed within the framework of a culture of dignity.

The main ideas of this article are implemented with the participation of the author in mathematics textbooks [5], in notebooks, in tables and in the computer component of the integrated teaching materials “Discovering the laws of the native language, mathematics and nature” [6], in the author's manual “Museum to School” [7] and in other manuals for younger students, in manuals and publications for students and primary school teachers [3].

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