VI GLOBAL SCIENCE AND INNOVATIONS 2019: CENTRAL ASIA

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МАТЕРИАЛЫ
VI Международной научно-практической
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Х.Б. Маслов, Е. Ешім, Е. Абиев (Казахстан), Лю Дэмин (Китай),
Е.Л. Стычева, Т.Г. Борисов (Россия)

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«GLOBAL SCIENCE AND INNOVATIONS 2019: CENTRAL ASIA» атты
VI Халыкаральық ғылым-тәжірибелеік конференция материалдары жинағына
Қазақстан, Ресей, Қытай, Турция, Белорус, Украина, Молдова, Қырғызстан,
Өзбекстан, Төкістан, Тұркстан, Грузия, Монголия жөғары оқу орындары
мен ғылым мекемелердің қызметкерлері мен ұстаздары, магистранттары,
студенттері және мектеп мүкәлімдерінің баяндамалары енгізілді. Жинақтын
материалдары жоғары оқу орындары мен ғылым мекемелердегі
қызметкерлерге, қызметшілерге, мектеп және коллеж мүкәлімдеріне,
магистранттар мен студенттерге арналған.

VI Международная научно-практическая конференция «GLOBAL
SCIENCE AND INNOVATIONS 2019: CENTRAL ASIA», включаю
доклады ученых, студентов, магистрантов и учителей школ из разных
стран (Казахстан, Россия, Китай, Турция, Белорусь, Украина, Қырғызстан,
Таджикистан, Молдова, Туркменистан, Грузия, Монголия). Материалы
сборника будут интересны научным сотрудникам, преподавателям,
учителям средних школ, колледжей, магистрантам, студентам учебных
и научных учреждений.


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Nowadays the pedagogical community shows a great interest in the relatively new concept of “computational thinking”. Professor of the Columbia University Jeannette Wing formulates computational thinking as a thought processes involved in the formulation of problems and their solutions, the solutions are presented in a way that can be effectively solved with the help of information processing tools.
Analysis of the actuality of various studies in the field of digital technologies using Google trends has shown the intensive introduction of computing in many areas of human activity. Computing is, on the one hand, the design and development of computer technologies, on the other hand, the field of knowledge, which includes computer science and many other disciplines related to information technology. If earlier computing was described as the concepts of programming technologies, computer networks, etc., nowadays the concept of computing requires the establishment of basics and fundamental principles.

Calculations being earlier the tools for solving various kinds of mathematical problems, data analysis, and business process management have become new scientific concepts. Active developments in the field of artificial intelligence and machine learning, robotics, nanotechnology, 3D printing, genetics and biotechnology are associated with computing. They penetrated into all spheres of human activity, became new methods for solving the problems of the world, and, as a result, new approaches to learning, to becoming a person with the knowledge and skills of the new millennium.

A need for computational thinking as a way of adaptation to the new digital world has appeared. “The ever-increasing informatization of the society demands a new indicator for specialist qualification, which can be formulated as the ability to understand and apply fundamental computational principles to a wide range of human activity. Thus computational thinking provides the basis for the continuous learning of new and advanced computational concepts and technologies” [2, p. 2].

According to education specialists, today, an ordinary person needs to have a number of special skills and abilities that help him to find his place in a changing world. The formation of a digital society requires the young generation to acquire skills for self-mastering new information and computer technologies and assessing their capabilities, abilities for the existence in online / offline reality, the constant updating of knowledge and the acquisition of new competencies.

The article aims to consider the emerged concept of “computational thinking”; to show the need for the formation of computational thinking of younger generation; to discuss possible ways of introducing computational thinking into the educational practice as an essential component of the digital competence.

For the first time the term “computational thinking” appeared in the publications of the Professor of mathematics and pedagogy Seymour Papert, who suggested using computers for the introduction of programming ideas into daily life. At the Massachusetts Institute of Technology under his leadership there was developed the LOGO programming environment that became a way of introducing computer into learning process not for studying it (which was natural in the 80s), but as “an object with the help of which people think” [3, p. 20] and actively study the world around. In recent years, the concept of “computational thinking” has been further developed in a number of works by foreign and domestic scientists. Among the Russian-speaking sources, we note publications [2, 4, 5]. These works highlight such components of computational thinking as abstract thinking, algorithmic thinking, decomposition, generalization, and the ability to think in terms of value [5, p. 76]. Computational thinking is considered as thinking, which includes many of the skills and abilities necessary for developing computer programs. Such computer science concepts as algorithm, recursion, decomposition, optimization etc. are also embedded in the concept of computational thinking.

The latest advances in the field of information technology have stimulated the need for the formation of a computational thinking from a young age. This kind of thinking is necessary for the development of a contemporary person who is capable to freely adapt to the ever-changing surrounding digital world. The European Commission Science Hub considers computational thinking as the most important skills of the 21st century. In many countries of the world, computational thinking have been added to reading, writing, and arithmetic as a key skill that needs to be acquired already in elementary school [6].
After the adoption of Decree No 8 “On the Development of Digital Economy”, in the Republic of Belarus, the transformation of education is getting started one of the goals of which is developing skills and habits of the 21st century for the younger generation. A large number of publications that have appeared recently contain a detailed analysis of the current state of affairs and suggestions for further adaptation of education to the needs of the emerging digital society. As practice shows, in a comprehensive school, technical and personnel support significantly limits the possibilities for solving the problem that has arisen, in other words, forming Computational thinking of schoolchildren. As an alternative, commercial educational services began to actively develop (centers, schools, academies, etc., de facto - courses in programming and robotics).

The IT community also understands the need and expediency of the formation of computational thinking from the early childhood, because it is interested in the mass preparation of future specialists for their field. As an example of the active participation of IT specialists in teaching schoolchildren is the joint educational project of the High-Tech Park and the Ministry of Education of the Republic of Belarus “Programming is the second literacy”. The aim of the project is the formation of basic ideas about programming languages, the development of algorithmic and logical thinking, the formation of certain skills for future professions related to IT.

Twenty years ago, mastering programming languages was not available to many students. The Basic and Pascal languages specially created for teaching programming were too abstract for the child. Scientists, educators and specialists in the field of artificial intelligence made numerous attempts to “visualize” the programming process for beginners and thereby make the programming process more accessible to children's perception.

Seymour Papert became the founder of the idea of block programming that makes learning programming as easy as building blocks of the constructor, where every detail has its own name and purpose. If the constructor is assembled correctly, you get the real working code. This approach is really simple and understandable for kids. The Scratch programming language has become the most common implementation of this idea, as evidenced by tens of millions of users registered on its official website [7].

Scratch was developed in 2007 at the Massachusetts Institute of Technology's Media Lab under the guidance of Prof. Mitchel Resnic. It is not only a block programming language, but also an online community in which you can share various interactive media projects with like-minded people from around the world.

Experience shows that Scratch can be successfully used to bridge the gap between "school" and “real” programming. The capabilities of this Scratch environment allow students to make acquaintance with various paradigms and programming technologies. Scratch popularity surpassed all expectations.

In the Republic of Belarus, many events are held to popularize Scratch and introduce it into the educational process. For example, in 2016 on the initiative of the companies-residents of the High-Tech Park, with the participation of the High-Tech Park Administration and under support of the Ministry of Education, a joint educational project on teaching Scratch programming for schoolchildren of classes 2-6 has been launched.

There was developed curriculum for elective courses; an experiment on the introduction of Scratch programming in a number of schools was organized. The Belarus Scratchers online community which is an association of teachers, parents and young developers in the Scratch programming environment who exchange useful information, provide all possible assistance to each other, and share their ideas has been created. The republican competition “Programming in Scratch Environment” and other numerous tournaments and competitions are held regularly.

When studying programming in Scratch environment not only logical and algorithmic thinking (as an integral part of the computational thinking) of schoolchildren is formed, but also their ability to work with various applications, multimedia, and new computer tools. Children learn
to develop computer programs for solving new problems of the world around them, to use their knowledge and skills in the study of other school subjects.

For students of 5-6th grades the authors have developed a number of problems for solving in the Scratch environment. Simple problems were used in order the students to get acquainted with the basics of structural programming, the problems of the Olympiad level had significant potential for the development of various components of the student's computational thinking.

The authors set the following problem - to provide students with a new level of abstraction and learn them to create their own operators, which can become “bricks” in the construction of more complex programs. For this one can use various techniques, for example:

– ask students to think about how the authors of the Scratch environment have programmed certain operators;
– show that it is convenient to give names to some complete code fragments so that they can be reused etc.

It is important to show the student that the phased design of the algorithm allows dividing a complex problem into simpler subproblems and implementing them in turn using such a powerful tool as procedures. At each stage, the decision is verified in practice. In the process of constructing code, individual fragments are debugged, their performance is assessed, and errors are eliminated. The final stage of solving is final testing. Such exercises are useful for developing skills in solving complex problems and developing such components of computational thinking as decomposition and abstraction. Schoolchildren develop a skill of recognition of "analogous" in different situations and the skill of using patterns that is one of the elements of computational thinking. When developing and implementing a number of algorithms, a schoolchild uses the previously acquired algorithmic skills stimulating the development of his logical thinking.

When studying Scratch students are acquiring such skills as

– formalization of conditions for the subsequent implementation of the solution on a computer;
– logical organization and analysis of data, use of computational skills, abstract data presentation;
– decomposition of a complex problem into simpler ones for the constructing algorithm;
– evaluation of the results;
– generalization and modeling of real phenomena and processes.

All of them undoubtedly will contribute to the formation of their computational thinking.

Solving problems in the Scratch environment allows to:

– not to be distracted by the syntax, as in the programming languages traditionally used in the school;
– develop not only algorithmic, but creative abilities of students.

It is obvious that natural sciences teachers are at greater length responsible for forming the computational thinking of the younger generation. The main components of computational thinking (abstraction, algorithms, systematization, etc.) are to a large extent are disclosed in mathematics, physics and computer science. Nowadays the problem of a teacher readiness to use their computational thinking in professional activity and develop it in their students becomes more and more topical.

References