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ADVANCED PEDAGOGICAL TECHNOLOGIES IN EDUCATION

PROGRAMMING AS ONE OF THE MAIN APPROACHES IN THE DEVELOPMENT OF CHILDREN'S KOMPUTATIONAL THINKING

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Abstract:

Objective. Digital technologies are developing so quickly that sometimes you don't even have time to grasp the essence of these technologies. Some "lighthouse" companies are rapidly introducing cyber-physical systems and artificial intelligence into their production in order to maintain their place on the world stage. In such a world, specialists are now needed who not only actively use these technologies, but also develop them. And how to prepare the growing generation for such a world where the integration of various scientific disciplines and discoveries is proceeding at a rapid pace, and where professions disappear en masse and new ones appear, which to a large extent require programming skills. All over the world they are discussing what skills and competencies we should equip the younger generation so that in the future they can calmly rule the world. Computational thinking is recognized as a necessary competence and skill set for the 21st century. Research shows that programming is one of the approaches to shaping and developing the computational thinking of adults and children.

Methods. Today they are trying to teach programming at all levels of the education system, starting with preschool. Two approaches are known, teaching basic programming skills, constructionism and fundamentalization of programming, and two strategies of unplugged and connected classes.

Results. The analysis of the tools used in the development of computer thinking of young children is made and is given in the form of a column.

Conclusion. The strategy unplugged is more suitable for the development of computer thinking in our country

Keywords: Technologies of the fourth industrial revolution, cognitive skills, socio-emotional skills, technical skills, computational thinking, unplugged, programming.

Introduction. The rapid development of information technology is changing our lives, views and worldview. We stand in an era where digital technologies are reinventing artificial intelligence and cyber-physical systems, technologies of the fourth industrial revolution. With a rapid pace of development and spread, this revolution has attracted an increasing harmonization and integration of various scientific disciplines and discoveries. So what skills and competencies should we equip our children with so that they can find their place in such a world where transformations take place almost daily. When we stand still in the previous third one [1].

The World Bank, in its 2018 report, cited the skills that modern people need: cognitive, socio-emotional, and technical skills. Cognitive skills are the ability to understand complex problems, adapt to the environment, learn from experience, cleverly overcome obstacles, and perform various reasoning. Cognitive skills are the foundations of other skills development and personal and professional development. These can be categorized into basic skills, which include basic literacy, numeracy, critical thinking, problem solving, and higher-order skills [2]. First, basic cognitive skills are formed, and on the basis of these skills, skills of a higher order are formed in the future.

Socio-emotional skills are the ability to work in a team, work on yourself, learn constantly, strive to be the first.

Technical skills are the knowledge, experience and interactions required by an employee in the workplace.

Cognitive and socially emotional skills complement each other and are

considered essential skills for the 21st century. Early childhood is the optimal period for their formation and strengthening occurs more in adulthood. An analysis of many foreign sources shows that the composite skills of cognitive and socially emotional skills like creative, critical thinking, problem solving, teamwork, learning are basic skills of computational competence thinking and activities based on it reinforce these skills [3-6].

Computational thinking is the cognitive percentage obtained during the contact of humanity with computing and digital technology [7] and has now become the main interests of specialists in many fields, especially programmers, teachers and psychologists. In fact, this skill was known from the 50s and 60s of the XX century as "algorithmic thinking" and from the 80s and 90s, "procedural thinking", introduced by S.Papert. Computational thinking has attracted the attention of scientists after J.Wing in 2006 introduced the term to science and described it as a fundamental skill for everyone, not just computer scientists. In her opinion, to reading, writing and arithmetic, we must add computational thinking to the analytical ability of every child. A study of the sources suggests that computational thinking is a broader concept than algorithmic and procedural thinking. Since then, many researchers study this term, give their definition and describe its components [4], but still does not have a specific definition and its components have not been strictly established. Let us give the definition of J. Wing: Computational thinking is the thought processes associated with the formulation of a problem and the expression of its solution (solutions) in such a way that a computer-man or a machine-can effectively perform [8]. By analyzing the sources, it can be seen that abstraction, decomposition, algorithmic thinking, automation and generalization are the most used components of computational thinking in the literatures. The evolution of computational thinking has occurred with the development of computer technology and information technology.

Computational thinking has influenced other disciplines. Computational biology is changing the thinking of biologists, the theory of computational games is changing the thinking of economists, nanocomputers, as chemists think and quantum computing, as physicists think [3].

There are scientific computational thinking, given as allowing to consider the emerging psychological structure as a new ability with its own essence, which must be specially developed and evaluated [9]. Scientists do not seek to establish the exact definition of orienting the components and components, they work on the development of teaching methods in classrooms, studying the impact of computational thinking on the academic performance of students and solving the problems of assessing this skill. All definitions are a general tendency to focus on the cognitive actions and processes of people. Accordingly actions based on computational thinking, mainly intended to improve cognitive skills to support learning processes [3].

Many works devoted to computational thinking show that one of the approaches to the development of this skill is programming [10, 11]. Scientists around the world see programming as a solution to problems in educating highly qualified specialists and programmers in the digital world and pay great attention to studying the impact of programming on the intellectual abilities of people. By creating a program, we force the computer to think, and of course this process affects our cognitive processes.

Studies have shown that teaching programming develops students' skills in problem solving [12], critical thinking [13], creative thinking [14], algorithmic thinking [15, 16], reflective thinking [17] and computational thinking [18].

Back in 1981, the metaphor “Programming is the second literacy!” uttered by academician A. P. Ershov has not lost its relevance, it can be said that it has regained its significance anew. He paid attention to the fact that programming as a mechanism for the transition from knowledge to action, an approach to the formation of human executive mechanisms, the expression of a person's organic ability, that is ability, prepared by the organization of his nervous system and inherent in man in all his social functions [19]. We can say that the construction and principle of operation of a computer are similar to a person. The process of collecting, processing and storing information, the tools involved in this process are almost the same. The main systems such as the musculoskeletal system and the nervous system are compared with the technical (hardware) and software of a computer, as well as the work of the central control apparatus, the brain and the central processor. The human brain controls the musculoskeletal system with the help of the nervous system, and the central processor controls the hardware with the help of software. And the process of solving the problem is also the same. When solving or performing a specific task, a person goes through some stages of creating programming such as design, algorithm, debugging and analysis [20]. Therefore, curriculum courses have a positive effect on the thinking processes of the teacher.

In addition, research shows that by 2030, over 57 professions are diminished and 186 new ones will appear. These professions are listed in the Atlas of New Professions. Atlas is an almanac of promising industries and professions for the next 15-20 years. It helps you understand which industries will actively develop, how new technologies, products, management practices will be born in them, and which new specialists will be required by employers [21]. Analyzing the research of the Atlas of New Professions, it can be concluded that 60% of the professions of the future have an average supra-professional skills and IT programming skills is in demand [22].

Based on the above problems, the ministries of education of many countries are considering the tasks of restructuring the system of education [23], they began to update their curricula, which is especially for the future[5, p.30].

At present, many foreign countries have begun to implement the framework programming into compulsory education starting in primary school. And even there is a tendency all over the world to introduce basic elements programming in preschool education. Young children are taught basic programming skills. As we know from research, training takes place in two approaches, the first approach is constructionism - the philosophy of learning developed by Seymour Papert on the basis of constructivism. Where ideas are formed and transformed in different contexts and where children learn by creating their own artifacts, whether it's product design, building a sand castle or writing a computer program. And the second approach to the idea of "fundamentalization of programming", justified by A.P. Ershov, where special attention is paid to the development of thinking, especially algorithmic, spontaneously and unconsciously, without imposing new skills and knowledge that are not peculiar to children.

The basic programming course begins with basics of algorithmization and algorithmization has two aspects: developmental and programming. The developmental aspect is aimed at the development of algorithmic thinking and programmer with an introduction to a specific programming language. The development of algorithmic thinking, a key skill of computational thinking, is carried out in classrooms in two strategies, unplugged and connected to a computer [9].

Methods. A lesson disconnected from a computer can be considered an initial and complementary stage of a lesson, where tasks are solved using a computer, this strategy itself as a separate strategy cannot act, at some stage it gives its place to the second strategy. This strategy is useful because it solves the problem of inaccessibility of technical software, limiting the time of work on the computer by sanitary rules and regulations, and supporting the physical activity of students. In this strategy, classes can be carried out in a playful way, and also practical tasks and in the form of tasks, puzzles, playing schemes and cards, robotic systems, video presentations, shows and even classes can be held outdoors [26].

The tools that are used in the classroom can be divided into the following types:

1. Funds disconnected from the computer;
2. Digital and programming toys or robotic complexes (physical devices);
3. Visual Programming Environment(VBA);
4. Computer games educational programming.

Since cognitive skills are formed from childhood, these skills can be formed and developed by focusing classes on programming. Let's consider the tools that are currently used in young children of programming. (see Table 1.).

Table 1.

Learning programming tools for young children

№	Name	Type	Approach	Issue	Developer	Age
1.	Pictomir	Game	Blocky (without text.)	2014	Research Institute of RAS	4+
2.	Bee-bot app	Game	Blocky(textless)	2012	TTS Group	4+
3.	Bee-bot	Physical.Direct	Input Device	2008	TTS Group	4+
4.	Scratch Jr	VPE	Blocky(textless)	2014	DevTech Lab MIT Media Lab	5-7
5.	LightBot Jr	Game	Blocky(textless)	2014	SpriteBox LLC	4-8
6.	Box Island	Game	Blocky(textless)	2015	Radiant Games	6+
7.	KIBO	Physical.device	Blocky(textless)	2017	KinderLabs Robotic	4+
8.	Dash and Dot	Physical.device / game/VPE	Blocky(textless)	2016	Wonder Workshop	5-11
9.	Code.org	Web Game	Blocky (partial text) and with text	2013	Code.org	5+
10.	Kodable	Game	Blocky (textless)	2012	SurtScore	4-11
11.	Robot Turtles	Board Game	Blocky(textless)	2014	ThinkFun	3-8
12.	Matatalab	Physical device	Blocky (textless)	2017	Matatalab	3+
13.	Cubetto	Physical device	Blocky (textless)	2013	Primo Toys	3+
14.	Code-a-Pillar Twist	Physical device	Blocky (textless)	2016	Fisher-Price	3-6

The use of digital and programming toys or robotic complexes solves the problem with the lack of technical and software tools, but requires knowledge and preparation for classes from the teacher. Of course, in the other two cases, knowledge and training in working with computers are also required, more effort and skill are required here to interest children in the lesson [25].

Results. In the classes of the second strategy, tasks are solved using a computer, programming is taught using online and offline tools. These can be ready-made platforms with lessons, or games, where there are programming elements, as well as free environments where you can independently create games, cartoons and postcards [26]. There are many games and applications that teach the basics of programming, the development of logical, algorithmic and generative thinking, such as CodeMonkey, Kodable, LightBot, SpriteBox, Cargo-Bot, Robozzle, Bee-Bot, PiktoMir, etc.

The emergence of block-visual programming environments made programming more funny, understandable and accessible for every ages starting even for preschool children. Programs such as Scratch, Google Blockly,Alice, Hopscotch, Snap, Gamefroot, Tynker for schoolchildren and preschool children Scratch JN teaches programming skills from childhood. The visual programming environment can serve as the initial stage of text-based programming and a patch for programming more levels.

Conclusion. Today, teaching children the basics of programming is based on the integration of two approaches, creating artifacts can achieve the development of komputational thinking, a necessary skill of the XXI century. Skills development can lead to structural transformation and economic growth, especially in the digital age, and make countries more competitive in the digital world.

In our country, where the computerization of education is not fully covered, it is possible to begin the development of computer thinking with a strategy disconnected from the computer, with the help of board games and digital toys or robotic complexes.

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