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Current Approaches to Organizing the Educational Process in Primary School: a Neuroscientific Approach

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Abstract: *The education system in the New Ukrainian School does not meet expectations, and therefore requires reforms and changes, involvement of modern approaches to organization of the educational process. This article analyzes various innovative neuropedagogical, neuropsychological and neurolinguistic techniques, proposed by scientists and educators-innovators and substantiates the importance of their implementation in the primary school learning process. The relevance of the topic is attributable to the need to solve pedagogical problems, using knowledge about individual characteristics of brain activity, higher mental functions and thinking strategies of primary school children. This study allows to make the educational process more effective and to ensure full self-realization of each child, as well as cognitive and personal development of primary school students. The article presents current provisions of research work of primary school teachers and psychologists from the standpoint of related to pedagogy neurosciences, as well as introduction of modern neuropedagogical, neuropsychological and neurolinguistic approaches to the practice of educational process in the New Ukrainian school.*

Keywords: *Neuropedagogy, brain activity, thinking strategy, polymodal learning, neuropsychology, laterality.*

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Introduction

Today's realities, such as rapid development of scientific and technological progress, globalization and the speed of social transformation (Florea, 2017), require constant changes from the New Ukrainian School, reforms and application of modern approaches to organization of the entire educational process. At the turn of the second decade of the 21st century, educators and scientists are well aware that these transformations need to be introduced starting from the lower grades. That is why study of innovative teaching methods has now become so relevant.

The problem of introducing new approaches to the education system in primary school was addressed by such scientists as Bibik (2010), Danyleiko (2017), Komogorova (2021), Kurylo and Ostroumenko (2019), Maksymchuk (2020a), Maksymchuk (2020b), Melnyk (2019), Melnyk, (2021), Onishchuk et al. (2020), Sheremet (2019), in particular, scientists from different countries – Kuzmina (2014), Larina (2016), Lipman (2012), Moskvitina and Moskvitin (2001), Naegele (2015), Sternberg (2019) studied introduction of neuroscience technologies in the modern school educational process. The issue of the use of neuropsychological and psychophysiological knowledge in the education process at secondary schools was first raised by neuropsychologists Luriya (1975) in the 60's and 70's of the last century, and in the 90's Khrizman (2009) singled out neuropedagogy as a scientific field.

The main facts that indicate the need for changes in our education system, scientists name first the fact that Ukraine ranks as high as 38 out of 76 in the ranking of secondary education systems among civilized countries. This allows us to trace a direct link between the level of education and the economic well-being of the state. Second, in our country there is no equal access to education among urban and rural residents, as evidenced by low scores of independent assessments and exams. Third, it turns out that school is the least reformed structure in Ukraine, which for decades has focused only on accumulation of theoretical knowledge. Whereas in modern society, practical skills are becoming increasingly necessary, and employers prefer people with additional socio-emotional and cognitive characteristics. In addition, teachers are now dealing with the modern generation, with children of the new "formation" (Bibik, 2010).

Research in the last decades of the twentieth and early twenty-first centuries in the field of science has shown that capabilities of human brain are truly limitless, mysterious and even extraordinary. It is not for nothing that scientists have called this time the "decade of the brain". It was during this period that people learned more about the brain than in all previous

centuries put together. Compared with the mental abilities of other animals, such as primates, dolphins, dogs, the human brain shows great flexibility, the ability to focus on several objects simultaneously, the activity of cognitive and speech centers, the ability to train them at all ages, the existence of individual strategies thinking.

These and many other discoveries gave impetus to the development of modern neuroscience. They are all based on the study of neural connections at different levels of organization (from the elementary molecular to the whole organism). There is a whole common field, which is called neuroscience. It was formed at the intersection of several disciplines, namely: biology (anatomy) and pedagogy, psychology, linguistics, sociology, etc. Neuroscience is expanding with the development of methodological and conceptual foundations, including in the context of cognitive neuroscience. One of the most interesting areas in the context of school activities of primary school students is neuropedagogy, neuropsychology and neurolinguistics.

The article presents current provisions of the research work of primary school teachers and psychologists from the standpoint of neuroscience related to pedagogy, as well as introduction of modern neuropedagogical, neuropsychological and neurolinguistic approaches in the practice of the educational process in the New Ukrainian school.

Neuropedagogical approach to learning in primary school

The basis of neuropedagogy is the use of knowledge of cognitive neurology, human psychophysiology, neuropsychological knowledge, data on the brain organization of processes of mastering various types of educational material, taking into account compatibility of individual thinking systems of students and teachers in the educational process.

It allows you to optimally and creatively solve pedagogical problems in practice, using information about individual characteristics of the brain organization of higher mental functions. This science is based on sensory pedagogy, i.e., the impact on the senses of students, their emotional state, thus it allows to increase the ability to learn and regulate the behavior of children in the process of mastering the educational material (Larina, 2016).

The main provisions, tools, tasks and goals of this latest direction of pedagogy were covered by Moskvitin and Moskvitina (2001) in their article "Neuropedagogy as an applied direction of pedagogy and differential psychology". This was one of the first works in the post-Soviet space. In parallel, this area of pedagogy has developed in the United States, which led to organization of the largest international project 'Brain and Learning".

This project brings together scientists from thirty countries. Its main goal is to popularize knowledge about the work of brain structures among teachers (Livshits, 2012).

Neuropedagogy in primary school takes into account the knowledge of how the child's brain develops and works in primary school children, how differs the way of thinking of boys and girls, as well as "left-handed" and "right-handed" students of the appropriate age, what happens in the brain of a child when attending school, which method of teaching writing or mathematics is better to choose depending on the individual characteristics of a child (Moskvitin, Moskvitina, 2001).

The main provisions of neuropedagogy include: considering brain as a "parallel processor", i.e. as a kind of biological "computer" capable of analyzing information and executing commands; perception of how the natural mechanisms of brain development work, as well as how energy-intensive physiological processes work, and therefore in the learning process it is very important to provide conditions favorable in terms of hygiene and nutrition; emphasis on past experience and search for knowledge as innate qualities of the brain.

Neuropedagogical scientists believe that our brain is looking for meaning through establishment of regularities. It is able to simultaneously analyze and synthesize incoming information, as well as operate on the whole and a part. Human brain is also a unique system, because it is able to absorb information simultaneously in the conditions of focused attention and peripheral perception, as well as operate at least two memory systems: the system of visual-spatial memory and the system of "rote memorization". The processes of consciousness and subconsciousness in the student's brain occur simultaneously, and the role of emotions in learning and teaching is fundamental. Children understand and remember better when knowledge and skills are "engraved" in the system of visual-spatial memory.

In addition, the whole learning process is perceived by scientists supporting theories of neuropedagogy, purely in the form of information movement through the human nervous system. They believe that when analyzing learned information, the child's brain activates a certain "master key", that opens the "door" for the train of thoughts. It is called modality, which is provided due to predominant use of one of the channels of reception and processing information (Kuzmina, 2010).

The concept of polymodal (multisensory) learning also appears in neuropedagogy. This is a kind of system of techniques based on knowledge and skillful use by teachers and students of the peculiarities of perception and processing of information by different sensory channels and different

hemispheres of the brain. In the context of group learning in the classroom (this is especially important for younger students, who often find it difficult to remember a large amount of material), it is necessary to take into account that there are children in the classroom with different dominant channels of perceiving information, and therefore it is necessary to provide comfortable conditions for all groups of students (auditory, visual and kinesthetic learners).

For example, when working with auditory learners, a primary school teacher should allow students to read texts in a whisper when working with a textbook; in order to attract attention, teachers should not raise their voice, but on the contrary lower it; during independent, control, homework, when studying new material, a teacher should turn on music.

Children with a visual perception of information need more illustrative material, pictures, diagrams, cards, i.e., visualizations, so that they can "see" information and then analyze it, pass it to the appropriate centers of the cerebral cortex and remember it.

Kinesthetic learners definitely need tactile contacts to perceive this or that information about objects and phenomena. Thus, they are often given tasks to compare values, units of measurement, numbers, letters, assembling puzzles, etc.

Development of a comprehensive methodological system of ways to organize cognitive activity, taking into account all channels of information, which develops learning abilities of each student of an experimental class, leads to effective absorption of theoretical knowledge by all children.

Thus, one of the promising areas in the theory and methods of teaching in neuropedagogy is associated with building of a special educational information environment, where methods of presenting information are based on relative equality of verbal, visual and kinesthetic ways of presenting information.

Neuropedagogical approach in teaching primary school children helps teachers to optimally adapt teaching methods to individual abilities and capabilities of each modern child. This approach is grounded on the basis of known modern achievements of neurophysiology and neuropsychology in the study of functional hemispheric asymmetry in the brain of first-graders, obtained directly during experimental work.

From the point of view of neuropedagogy, scientists offer a pedagogical system of synthesized learning, taking into account natural specifics of thinking; emphasis is placed on the methodological aspects of synthesized education of children with different lateralities in one class and at one lesson in primary school.

All scientific research is conducted to overcome certain difficulties in understanding new phenomena or to explain previously unknown or not fully substantiated facts or theories. These difficulties manifest themselves in the most expressive form in "problematic situations" when "the existing scientific knowledge is insufficient to solve new modern problems of cognition" (Larina, 2016).

The problem that has given rise to research is related to the search for individual approaches to children's learning in primary school, as each student has his or her own "nature of thinking", so students' learning abilities are different at first. To teach with good results, it is necessary to proceed from the needs and abilities of a child, and for this purpose it is necessary to carefully study thinking strategy of a student. From the point of view of a neuropsychologist, "thinking is activation of groups of neurons" (Larina, 2016). Neuropedagogy helps teachers to understand the brain organization of students and adapt teaching methods for them.

The brain of a student, say a first grader, at the functional level is a stable structure. In standard conditions it should be developed by a teacher, that is why any "departure from the normal way of development may lead to its functional deformation, even in an initially healthy child" (Yeremeeva, 2017).

So, we need to know the subject we are dealing with every minute. In our research, attention is paid mostly to the child's forebrain, which is "represented by two large hemispheres, closely adjacent to each other, like twin brothers. They are connected by several bundles of nerve fibers – corpus callosum, the channel of communication between the hemispheres and function as a single consciousness. Interaction of these three neurostructures takes place "according to the laws of unity and struggle of opposites, unity of preservation and stability, disorder and order, natural and accidental" (Yeremeeva, 2017). This "regular disorder", or brainedness, and determines the emergence of such a concept as variability of thinking.

Depending on the individual priority activity of the hemispheres of the child's brain, the following types of development can be distinguished: the type of predominance of right hemispheric development defines right-handed individuals with the leading left eye and ear; this also includes sinistrals and ambidexters (two-handed); the type of predominance of left hemispheric development defines right-handed with leading right eye and ear; "Equilateral" (mixed) type defines right-handed with divergent leading eye and ear. In addition to the presented priority methods of information processing, it is important to know that the left and right hemispheres are connected by a "corpus callosum", the so-called conductor of information,

which allows to integrate it, recode and activate both hemispheres. But this "bundle of nerves" matures long and slowly, especially in boys (Glushchenko, 2017).

Over the last two decades in the field of education, the thesis of the methodological "conflict" of styles of presenting information in the educational process by teachers and styles of information perception by students has been persistently approved. The essence of the contradiction lies in the "left hemispheric teaching strategy" and the "right hemispheric" thinking strategy of some primary school children (Kuzmina, 2010).

To avoid this in learning, it is necessary to clearly understand specifics of the child's mental activity and from this point to build teaching technology. To confirm the hypothesis of the existence of different thinking styles of first-graders, experimental teachers diagnosed functional and hemispheric asymmetry, thus pursuing solution of the following tasks and proved validity of this theory (81% of children had a mixed type of thinking) (Glushchenko, 2017). They focused on a synthesized approach to learning and developed fundamental methodological aspects of the lesson that correspond to the humanistic principles of education. Including the following:

1) Learning to set goals and set a learning task, a step-by-step detailing of goals, their implementation and receiving feedback. For the "right-hemispheric" primary schoolchildren, understanding and achievement of goals is the main element of motivation for self-knowledge.

2) Variability of mental activity strategies during a lesson. Changing methods and forms of work. Prolonged monotonous activity contradicts the sensory thinking of "right hemispherics".

3) Own promotion in education materials fixing one's difficulties and ways to overcome them. Every child should have the right to get their own time to learn the material, with the speed of their perception to be on the same level of success.

4) Priority of thinking over knowledge. "One step in learning can give ten steps in a child's development and ten steps in learning can lead to one step in development" (Vygotskiy, 1996).

5) Assessment of the level of knowledge, skills and abilities in comparing personal success of students with their personal achievements. We teach the principles of self-esteem and ways to improve their own results.

6) Formation of cooperation thinking of children with different laterality. Learning collaboration in groups or pairs, where children with different thinking priorities share learning strategies. For the "left-

hemispheric" students, the right hemisphere is the most important; classic landing at desks. For the "right hemispheric" students, on the contrary, the left hemisphere; landing in a semicircle. "Outside these conditions, the loss of information can be up to 30%" (Glushchenko, 2017).

7) Emotional support throughout the lesson. The use of vivid expressive examples, associations, language and musical rhythms, due to emotional basis for the study of material that provides a natural increase in efficiency, "increasing efficiency of the brain" (Akhutina, Zolotareva, 1997).

8) The priority of student initiative, activity and independence are fundamental factors of motivation for continuing education.

9) Differentiation of tasks at the individual level.

Thus, neuropedagogical methods are a necessary component in the New Ukrainian school, as they best meet the principles of individualization, humanization and cognitive approach to organization of the educational process in primary school.

Neuropsychology and teaching primary school children

Neuropsychology is based on the assertion that each person is a hierarchically organized, self-regulating "neuropsychosomatic" system that includes three parallel areas that cannot exist without one another. Deciphering this definition in parts, it turns out that "neuro" is associated with activity of the nervous system of an individual, the main organizer of which is his or her brain. "Psycho" reflects mental activity of an individual, and "somatic" is physical, which means existence of an individual as a biological creature, implementation of life processes through a set of internal and external organs and systems. All these components by themselves do not exist in nature. Failure, delays, distortions or advances in the development of each of these facets lead to disintegration or restructuring of the entire system (Sirotyuk, 2003).

The neuropsychological approach in following up education of primary school children, aims to raise children who are physically, morally and intellectually healthy. Changing the paradigm of pedagogical education turns it essentially into a psychological and pedagogical. The priority of the new educational standards in school is implementation of the developing potential of education.

But in recent years, psychologists working in the field of education, note a significant increase in the number of children with mental disabilities, note an increase in the number of primary school children who have difficulty in learning and mastering school programs. The probability of escalation of learning failures into chronic failure increases. Such children

have difficulties in mastering writing, reading, calculating, learning and understanding the meaning of texts, logical thinking. Failures at school often form in them a negative attitude to learning, make it difficult to communicate with parents and peers, i.e., in the microenvironment in which the child grows up. The state of long-term school failure contributes to formation of deviant behaviors, social maladaptation of students in life.

Early learning of children significantly exacerbates problems of schoolchildren in acquisition of knowledge. This is especially true for boys, whose brain maturation rate is slower than that of girls. It was found that about 25% of first-graders are not ready for school, 30 - 64% of children show functional immaturity without signs of mental retardation. 85% of children born after 1991 have neuropsychological problems due to stem changes in the brain. The brain of such children works due to compensatory mechanisms. Traditional conventional psychological and pedagogical methods of correction, unfortunately, in many cases do not bring noticeable results (Kuzmina, 2010).

Learning is a complex cognitive activity that is carried out by interaction of different brain structures. The timeliness of education and the full value of functional systems are a psychophysiological basis of higher mental functions, mental forms of activity and success in child's learning (Sirotyuk, 2003).

Formation of child's psyche is directly related to the rate of growth and maturation of their brain. Partial deviation or disturbance in this process leads to complications in mental development. The school program is always designed for a certain level of development of functional capabilities of an organism, and the child cannot begin to acquire knowledge until his body and, in particular, the CNS (central nervous system) are ready for this process. Neuropsychological studies show that underdevelopment of the frontal lobes of the brain is invariably beset by disturbance of personality components.

The process of mental development of primary school children should be based on a harmonious correspondence between the psychophysiological capabilities of children and requirements of their social environment. It is known that foundations of knowledge are laid in the early school years, so gaps at this age will be difficult to fill later. In this regard, the relevance of prediction and correction of mental development of primary school children is growing.

Maturation of brain, according to psychologists, is a long process and uneven in its areas and levels according to the age stages. The brain

develops by layering new levels over the old ones, which create a kind of a base, stated Vygotskiy (1996).

In the first stage (from the womb to 2-3 years) the basis for interhemispheric support of neurophysiological functions underlying somatic (physical, affective and cognitive) status of the child is laid.

The second stage (from 3 to 7-8 years) is most interesting to us, because at the end of this stage a child goes to school. The second area of the brain provides organization of memory processes, fixes hemispheric asymmetries, forms the predominant function of the hemispheres on the language, individual lateral profile (combination of the dominant hemisphere and the dominant arm, leg, eye, ear, functional activity). This means that each objective perception is the result of polymodal activity, which, first in ontogenesis, has a developed character and only then becomes collapsed. Therefore, such activities should be based on the joint work of different areas of the cerebral cortex.

For maturation of the functions of the left hemisphere, a normal course of ontogenesis of the right hemisphere is required. For example, it is known that phonemic hearing (semantic recognition of speech sounds) is a function of the left hemisphere. But before becoming a link in sounds recognition, it must be formed and automated as a tonal "sound recognition" in the right hemisphere through a comprehensive interaction of the child with the outside world. Deficiency or non-formation of this link of phonemic hearing can lead to delays in language development. The third stage (from 7 to 12-15 years) is a functional block of arbitrary regulation and control.

Specialization of the large hemispheres in the brain of each child occurs at different pace - creative in 4-7 years, and logical - in 9-12 years. The more actively both hemispheres and all parts of a brain are used, the more connections are formed in a corpus callosum. Integration and rapid access to information stimulate development of operational thinking and formal logic. Girls and women have more nerve fibers in the corpus callosum than boys and men, which provides them with higher compensatory mechanisms (Vygotskiy, 1996).

By the time children start going to school (at the age of 7) their right hemisphere is developed, and the left is actualized only by the age of 9. In this regard, education of primary school children should take place in a natural for their age right-hemispheric way: through creativity, images, positive emotions, movement, space, rhythm and sensory feelings.

Transition from one stage to the next one is strictly limited by objective neurobiological laws, which should be taken into account when

requiring a child to perform a task, because if it contradicts or precedes the situation relevant to their brain, it is energy stealing. This negatively affects formation of those processes that are currently actively developing.

Timely neuropsychological correction of existing difficulties allows to bring any kind of ontogenesis (atypical, pathological) close to the normal course, to facilitate a child's entry into a normal social environment. So, it is necessary to be guided by one of the main principles of development, the principle of timeliness (Kurylo, Ostroumenko, 2019).

Neuropsychological studies have defined profiles of "difficult" children, which have different nature, as their failure is based on various mechanisms (dysfunction of the frontal, temporal, parietal, occipital, left hemispheric, right hemispheric, trunk, commissural parts of the brain), according to which neurocorrection it applied (Akhutina, Zolotareva, 1997).

The neuropsychological approach has its advantages because it relies on peculiarities of memory, attention and thinking operations. Since the main activity in primary school age is still a game, a teacher should create special game situations, association tasks "associative bush", "associative chain".

The structure of each developmental process should include: exercise (which normalizes hypertension and muscle hypotonia); breathing exercises (improve the rhythm of the organism, develop self-control and arbitrariness); oculomotor exercises (develop hemispheric interaction, increase the body's energy level); cross-body exercises (activate the vestibular apparatus); exercises for development of fine motor skills of the hands; exercises for development of communicative and cognitive spheres of a child studying in primary school.

Organization of such classes allows the teacher to apply all available professional experience for variability of the used exercises (work with water, clay, plasticine, dough, pencils, paints, felt-tip pens, toys, etc.), and also gives a child the opportunity to learn to control the psychoemotional state, to reflect somatic feelings, plan and organize time and space around oneself (Danyleiko, 2017).

Using practical and theoretical experience in neuropsychology, one can harmoniously integrate into the learning process of primary school, with little effort required from the school administration (in the form of orders and instructions on the organization of the process), teachers (accepting the need for additional measures for children development) and parents (daily classes, correction of child-parent relations, improvement of relations with children) (Kurylo, Ostroumenko, 2019).

Thus, neuropsychological support of participants in the educational process will increase its effectiveness. Thinking, attention, memory are the higher mental functions that are not at the base of the pyramid, but rather high on it. The child's development goes from the bottom up. Each floor rests on the foundation of the previous one. To climb to the top of the pyramid, when the child is ready for school, it is necessary to pay attention to each floor, so that the personal, cognitive and moral development of primary school children was diverse and harmonious.

Neurolinguistics in the education of junior students of the New Ukrainian School

Formation of children's language competence, starting from the first years of school, from the standpoint of neuroscience is also quite an interesting topic. The sound aspect of language is mastered by both hemispheres in different degrees of activity: the left one provides phonemic perception, the right one – the relationship between sound and content (Luriya, 1975).

The phonemic principle of teaching reading and writing has been a priority for more than 30 years in school. It is known to be the basis of modern traditional methods of language learning. However, this principle, which considers all learning from particular to general, from sound to letter – left-hemispheric learning strategy, i.e., focused only on "the right-handed" students.

That is why for children who write with the left hand, it is better to use other methods. Then the technologies and achievements of neurolinguistics come in handy. One of them is a suggestive technique. It attaches special importance to the psychological mood and emotional state of students. This technique actively uses music, movement, stage action.

Indeed, right-hemispheric thinking of a 5-7-year-old child (reading learning period) is very difficult to cope with phonemes dressed in schemes, especially in phonemic hearing disorders, and "the cubes with letters" that differ in weight, vibration of the filler, combinations of features in Zaitsev's method are closer and understandable to the sensory and figurative perception of "the right-hemispheric" children.

However, despite some priorities of the latest approaches, learning on the basis of phonemic analysis cannot be ruled out, this technique brings positive results for children of "equal" and left hemispheric types of thinking. Sirotyuk (2003) writes: "Left hemispheric people evaluate and read words by "attacking" them, so it is necessary to use a phonetic (discrete) approach (part-to-whole)" (Sirotyuk, 2003, p. 24).

Akhutina (1997) also points to the difficulty of handling spatial information in weak students. If a student reads a word from the end, according to the scientist, it indicates the weakness of a holistic strategy for processing visual-spatial information. Global reading and whole word reading are inaccessible to these children. They master such skills analytically, based on an analytical strategy of perception (Akhutina, 1997).

Writing is an asymmetric activity of the reading process. In the process of learning to write a letter, it is important to activate figurative thinking, children easily remember the auditory, articulatory image of the word, kinesthetic (from the printing hand), visual image. Yeremeeva (2017) draws attention to the fact that rhythmic writing to music (for example, writing elements of letters) is very important for a child. This activity, like reading, should be rhythmic to breathing. Continuous writing is difficult for a child to master. A left-handed child should not be required to write letters inseparably (Yeremeeva, 2017).

In the first stages of learning to write actions are performed in a slow rhythm, the transition from one operation to another requires a delay to realize further action. As the experience of teachers shows, the most productive of the current methods is the method of "the joy of knowledge". A complex of methodical actions forms muscular and tactile memory, improves analytical and synthetic abilities of children. In the methods of writing a letter offered by Potapova, we find both analysis of the letter and synthesis of the letter from its constituent elements. Creating compositions to practice the line is an opportunity for creativity.

The relationship between activity of the right and the left hemispheres is different in perception of literary and technical texts. In the process of reading technical texts, the left hemisphere is more active, and when reading fiction – the right one; when reading, the left hemisphere of the brain encodes printed characters, and the right one – finds the meaning of decoded information.

The speech of "right-hemispheric" children is usually poor in adjectives and verbs, it is difficult for them to remember words out of context. Therefore, it is not recommended to do all the vocabulary work before reading the text. Thanks to intuitive right hemisphere thinking, it is easier for children to understand abstract nouns (love, care, fear) through the context.

Detailed retelling is difficult for the "right hemispheric" children, they do not see details, especially after independent re-reading. Small but succinct works, filled with deep meaning are a wonderful intellectual platform for "brainstorming", in which "right hemispheric" children

participate with pleasure, because they are capable to comprehend the incomprehensible (Luriya, 1975).

Children with different types of thinking write the work differently. Some need a support plan, others find it interfering, so when working with younger students it is necessary to synthesize learning strategies in preparation of the work, i.e., for the success of creative "thinkers" it is necessary to equip them with the "left-hemispheric" thinking strategies equally, tech them to overcome obstacles.

Thus, the use of neurolinguistic techniques at writing and reading lessons in the New Ukrainian School is extremely appropriate, as it is aimed at formation of language competence in younger students and their effective cognitive development.

Ideas of Western scientists concerning neuropedagogical techniques in primary school

In the post-Soviet countries, the leading ideas of the neuropedagogical direction are propagated mainly by Russian scientists. However, development of this science abroad has been going on for over three decades. The neuropedagogical approach to education of primary school children is actively promoted by scientists in the United States, Great Britain and Italy, in particular professors at Oxford and Yale universities. We analyzed the most interesting ideas and methods of Western scientists, which can be adapted to the realities of the New Ukrainian School and be applied in teaching primary school children.

The American scientists Wolf and Washington (2013) in their work "Mapping the Brain onto the Mind" consider a child's brain as a reflection or a kind of a "map" (by analogy with geographical maps, which are used to study countries and areas). Peculiarities of students' mental development are a certain territory, and teachers' and scientists' ideas about it are a "map". However, unlike geography, physiology is a much more complex science, because not everything that should be on the "map" of the human mind is actually in it.

When talking about mental development, then from a physiological point of view we mean development of the brain, and from a psychological point of view – development of its properties (level of intelligence). The latter depends on how accurately the human brain is able to process input signals. Therefore, the pair "brain-intelligence" is interdependent, because it has a two-way relationship as the brain depends on the level of IQ, so the intelligence depends on the brain structure.

Critical thinking is understood as higher-order thinking based on information, conscious perception of one's own intellectual activity and similar activity of others, and the lateral thinking is thinking that is shifted (redirected) relative to traditional thinking. "Mind-maps" are a reflection on paper of a kind of effective way of thinking, remembering, solving creative problems, as well as the opportunity to present and visualize one's internal processes of information processing (Wolf, Washington, 2013).

Thus, the teacher's task is not to divide children into groups of "smart" and "stupid", attaching to children a kind of labels, but to create conditions for development of their intelligence and brain.

However, the same neuropedagogical and neuropsychological research may be interpreted differently by different scientists, as there are many levels at which the same idea or fact can be analyzed. Therefore, scientists often suggest that biological effects are the cause of individual differences in students' mental abilities, not their consequence. However, the learning itself leads to changes in the structure of the brain (assimilation of new information always entails formation of new connections between the existing neurons in the human brain).

This idea is shared by Professor Sternberg of the University of Cornwall, USA (2019). He argued that when talking about mental development, it is more appropriate to "focus on teaching methods, rather than go down to the level of biological analysis of the students' mental abilities". It is impossible to specify a perfectly correct level of interpretation of a child's thinking, but if "we seek to help students learn, then we will go much further in researching cognitive learning strategies rather than electrochemical reactions in their heads". He also noted that it is important for younger students to develop "practical" intelligence aimed at real life in the future, rather than "standard" intelligence (academic knowledge) (Sternberg, 2019).

Personality-oriented learning technologies, which should be considered in elementary school, also have their origins in the United States. It was in this country in the 70s of the twentieth century that a new program called "Philosophy for Children" appeared. It is a technology of teaching philosophy at school, which was formed by the Institute for Development of Philosophy for Children, chaired by Matthew Lipman (2012). It aims to systematically teach, through philosophy, the skills of rational reasoning – evidential, independent, contextual and critical – in order to prepare the intellect for acquisition of new knowledge and to educate a morally and socially responsible person.

Instead of the traditional information model (notification of personalities, directions, disciplines, etc.), it uses a problem-activity based method of knowledge transfer. This leads to transformation of the classroom into a community of researchers, organization of lessons on the principle of a dialogue, enables giving students fiction and short stories instead of textbooks that have philosophical features and a provocative nature, which stimulates reflection. This technology is one of the integrative techniques that should be used starting from the primary school. "Education will only make sense when the student sees its meaning" (Lipman, 2012, p. 12).

The previous idea confirms that not the intellectual abilities of the student, but his self-awareness should be both the goal and the criterion of effective educational process, as self-awareness is the most important factor in the socialization of a human, their harmonious integration into society.

This conclusion is confirmed by observations of Frankl (1990). They argued that boys' behavior and future life prospects could not be fully "extrapolated and predicted from family conditions through analysis of school, social experiences, and sociocultural influences, medical records, academic performance, hereditary background", or other factors. Much better "predictions are given by the degree of self-awareness" (Frankl, 1990, p. 81).

The brain is able to simultaneously analyze and synthesize incoming information, to operate equally well both a whole and a part. Neuropsychological studies show that the brain has a unique ability to "see" an object simultaneously as a whole and in parts, at the same time to divide and integrate it. That is why analysis and synthesis are a unity of two very important, constantly interacting mental processes in learning, the joint development of which requires appropriate reinforcement through adequate techniques and methods of learning. Under such conditions, the educational material should be presented in the mode of constant interaction of the whole and a part, analysis and synthesis, induction and deduction, direct and inverse methods of solving problems and proving theorems, concretization and generalization of the studied information.

The educational process appears fundamentally resonant when participants of an educational process resonate with each other. At the level of the neural organization of the human brain, the principle of resonance is realized in the phenomenon of so-called "mirror neurons", which was discovered by the Italian neurobiologist Giacomo Rizzolatti (1998). He showed that there are unique cells in the human brain that are activated in an inversed manner when we closely observe other people's actions.

Versatile (for example, communicative) actions of a person, accompanied by activation of the corresponding structure of neurons in their brain, cause activation of the same structure of neurons in the brain of another person who monitors these actions. This is implemented similarly both in the context of the evoked potentials of the brain (when the frequency characteristics of sounds perceived by an individual generate a course of brain processes that are characterized by the same frequency characteristics) and at the level of ideomotor reactions (when in the brain of an individual who imagines certain physical movements, nerve impulses that occur during real physical movements are detected) (Rizzolatti, 1998).

Another American scientist, Sarah Naegele (2015), argues that neuropedagogy in its basic state begins with the skills of executive function and development of the prefrontal cortex. She emphasizes that educators need to combine neurobiology, psychology and pedagogy to implement improved teaching methods and curricula, as "learning physically changes the brain". We are talking about the neuroplasticity of the brain, which allows teachers to attract new methods in teaching.

Based on her own research, Naegele (2015) says that the most effective use of neuropedagogy is in three areas: neuropedagogy of brain elements, body elements and mind elements. The learning hierarchy depends on prior knowledge of brain functions. The body and its organic processes are the next step in learning to understand the relationship between inertia and control, because not all learning tasks of younger students can be fully achieved without a clear understanding of how the brain and body embrace physiology of the mind. The main reason for exchange of information is learning, and it can be understood only if there is sufficient brain function. This is the basis for understanding CNS neurotransmission, using approximate mapping of the cerebral hemispheres, and raising awareness of the undoubted impact of the digital society on the organic brain.

Organization of a hierarchy of understanding, based on the processes associated with neurotransmission in each part of the brain at any moment of time, allows to understand the powerful effects of neuroplasticity, i.e., the infinite ability of the brain to change itself. The learning process that begins with the brain and passes into the body. Therefore, it is important to activate the sensory data processing system, a boundless potential of multiple intelligence and emotional intelligence (EQ), the culmination of which is the child's interaction with the macro environment.

The scientist notes that in teaching children it is necessary to take into account the state of development of neuroplasticity of their brain,

theoretical and emotional intelligence, to form a cycle of habits and behaviors aimed at the desire to learn, to create not a cliche model of education, but an "atmosphere of curiosity" for younger students (Naegele, 2015).

Conclusions

Therefore, knowledge and use of the principles of modern neuroscience, in particular, neuropedagogy, neuropsychology, and neurolinguistics in educational activities in primary school allows the most effective development of new teaching methods. Nowadays, neuropedagogy and neuropsychology have experimental and theoretical studies of functional development of the child's brain, which allows to differentiate the learning process, change the approach to the system of diagnosis and correction in the school education system.

Study of the functional asymmetry of the child's brain confirmed the hypothesis that the primary school requires a comprehensive synthesized technology for teaching children, taking into account individual strategy of thinking. These approaches encourage teachers to adapt teaching methods not to the level of the student's intelligence, but to his cognitive abilities.

Modern scientific research in the field of neuropedagogy and neuropsychology encourage us to create a continuous educational environment, when the focus of any pedagogical technology is the student's personality as the "key character" in the learning process in the New Ukrainian School.

The most successful model of the educational process is based on the fundamentals of neuropedagogy as a science of learning and development of the child on the principles of brain functioning. It allows to ensure complete fulfillment of each representative of the younger generation, as well as cognitive and personal development of students of the New Ukrainian Primary School.

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