DIRECTIONS AND TRENDS IN THE DEVELOPMENT OF NEURODIDACTICS

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In modern neuopedagogical research, promising directions for the development of neurodidactics are quite clearly traced: conceptual design of neurodidactic technologies, individual and typological differences in the organization of the brain, motivation for learning, the emotional-motivational component of learning, neurodidactic principles of designing a modern educational environment, diagnostics of the initial level and others. These promising areas of neurodidactics development are constantly being supplemented due to the intensive development of this pedagogical branch.

Abstract. In this article the main directions for the development of neurodidactics are identified. The author highlights individual and typological differences in the organization of the brain, motivation for learning, the emotional-motivational component of learning, neurodidactic principles of designing a modern educational environment, diagnostics of the initial level and others. These promising areas of neurodidactics development are constantly being supplemented due to the intensive development of this pedagogical branch.

Keywords: neurodidactics, neurodidactic technologies, the brain, neurodidactic principles, valeological neurodidactics

In modern neuopedagogical research, promising directions for the development of neurodidactics are quite clearly traced: conceptual design of neurodidactic technologies, individual and typological differences in the organization of the brain, motivation for learning, the emotional-motivational component of learning, neurodidactic principles of designing a modern educational environment, diagnostics of the initial level, learning styles and dynamics of educational achievements, valeological neurodidactics, methods of objective assessment of education, stimulation and training of cognitive and regulatory functions, introduction of artificial intelligence systems into teaching, the effect of sleep on learning and memory, neurodidactics in telelearning and others. Let's comment on the selected areas.

The first direction - the conceptual design of neurodidactic technologies - is based on the dominant principle of neurodidactics: "BrainBasedLearning" (learning based on the laws of brain functioning). This principle defines any neuopedagogical technology that uses data about the human brain and mental activity. The models being developed today transfer the data of neurosciences to the principles and techniques of constructing the educational process.

However, following the research team of neurodidactists (M.P. Karpenko, D.G. Davydov, E.V. Chmykhova, L.M. Kachalova, V.V. Loginov), we state the transformation of the named principle into the paradigm “Learning by the laws of the brain and its development through learning.” The indissolubility and mutually enriching nature of the brain and learning has been proven by modern research and opens a new page in neuroscience and education.

The direction of individual and typological differences in the organization of the brain is multifaceted. It raises questions about 1) the difference in the brains of people of different races and cultural groups, the ways of their thinking (emphasis on analysis and logic in Western culture, on intuition and creativity in Eastern culture), 2) gender specificity of thinking (fixation on one aspect of information and its analysis in men and parallel processing of information, its multifaceted analysis - in women and other phenomena). Introduction to the research activity of "female" analysis [1, P.45], which is typical for the
majority of students studying in universities in the country by gender, can give a new impetus to the “young science”, expand its methodology.

The attention of didactics and learning psychology to motivation is well known: almost all technological chains are preceded by it. The position of neurodidactics on this issue is that the brain is curious: it constantly encourages itself to search for new information. This process manifests itself in the interest that stimulates the search. The transformation of educational information, which is necessary, but difficult for perception, into interesting, personally significant, mobilizes thought processes, significantly reduces the time for its assimilation and thereby optimizes the educational process.

It proceeds effectively when the motivational component of learning is accompanied by an emotional one. The interaction of the cognitive and emotive brain imparts a controlled beginning to the didactic learning process, activates memory as much as possible. Learning practice can be enriched by both the study of positive and negative emotions, equally intensifying the cognitive process. In the latter case, one should take into account the ethical side of the issue, the boundaries of the permissibility of the emotional factor.

Despite the relative development of neurodidactic principles for designing a modern educational environment, this problem is not sufficiently implemented in education due to its scale. This environment is mediated by well-established educational architectonics and is a stable factor. Its new neurodidactic profile is formed gradually with the growing number of research organizations, neuroscientific developments, neuropsychoeducational courses and programs in organizations of basic and additional education. A promising direction in this area is the creation of an enriched educational environment. The growth of synaptic contacts is determined by the information saturation of the environment. At the same time, an optimally functioning brain is characterized not by a larger number of synapses, but by their optimal structure. Therefore, for the learning process it is recommended not only the appearance of new synapses, but also the removal of "redundant" ones. In this regard, the training process should create conditions for intensive brain work. These conditions include saturation, diversity, technologization, individualization of training, and brain training.

The richness and variety of the didactic process are its indispensable attribute, since they stimulate attention, mental activity, and emotional intelligence. Here we also mention the reasonable sufficiency of methods and means to avoid dispersion of attention. Classical lesson planning helps the teacher choose the best means to achieve the goal.

The technologization of education offers a promising neurodidactics methods, models, and technology. For example, a very interesting research area is neurodidactics in TV-education.

Individualization of learning within the framework of tuning the educational environment (settings for a specific student) is associated with diagnostics of the initial level, learning styles and the dynamics of educational achievements. To the greatest extent, such diagnostics are in demand in addressing issues of career guidance and professional selection. The assessment parameter is the development of the brain areas responsible for the ability to actively search in non-standard situations or fine routine work, to communicate, to organize and control, to spatial orientation, etc. Diagnostic sheets of students can act as methodological responsibility (flight, marine, space universities) - functional magnetic resonance imaging.

Next, we will focus on brain training in view of the novelty and promising nature of this area. Neurodidactics (E.V. Chmykhova, D.G. Davydov and others) recommend introducing brain training into the educational process as an element of health technologies. Such training includes trainings of brain plasticity, "brain-fitness" (instrumental embodiment of psychological trainings), trainings of neurofeedback based on biofeedback technologies and used so far only in medicine [2, P. 159–167].

Valeological neurodidactics is aimed at organizing a healing educational process. Based on the conclusion of specialists in the field of pedagogical valeology (L.B. Dykhan, V.S. Kushin, P.G. Trushkin [3, P.4]) it can be argued that training may not become a burdening factor for health as usual, but provide health-improving, strengthening effect.

Described in the dissertation of M.A. Gaitukiev [4] valeological literacy, developed on the basis of a knowledge-based approach in younger schoolchildren, is designed to become a health-preserving base and form valeological competencies in students. The author believes that the most sensitive age for mastering the cognitive side of valeological competencies is the period of 6–9 years, when the child's mental activity is actively developing. The transition from visual-figurative to verbal-logical, conceptual thinking correlates with the formation of valeological literacy. The author's technology provides for the formation of motivation in primary schoolchildren for valeological literacy, mastering the basic valeological concepts and their meanings, studying the basic functions of the human body and their own biological capabilities, informing students about health risk factors and their prevention, ensuring readiness to lead a healthy lifestyle and stimulating subsequent brain development: eat right, get an idea of sanitary and hygienic standards and health-preserving labor, observe hygiene of study and rest, get an initial idea of a healthy lifestyle, bad habits and their prevention.

M.P. Karpenko writes about the development and implementation of design ergonomic requirements for the educational academic environment, taking into account the cognitive activity of students [1, P. 117]. Such requirements should be based on a preliminary assessment of educational products for the level of cognitive load, accessibility, reduction of exam anxiety, monitoring for objective psychophysiological parameters and subjective parameters of well-being.

Let us supplement these requirements with the temporal characteristics of students mediated by the brain, which affect their thinking and working capacity. In philosophy, time is correlated with individual consciousness (J. Berkeley, E. Mach, D. Hume), with sensual contemplation (I. Kant). The temporal structure of consciousness is emphasized by psychology (V.I.Kovalev, A.A. Kronik, N.F. Maslova, E.I.
Golovakha, D.Sh. Matros, V.V. Orlovskaya, etc.) With objective reflection in the brain the duration, speed, sequence of phenomena and events identified time D.B. Elkonin [5, P. 57]. The scientist believed that the human brain does not have a special analyzer for the perception of time. According to I.A. Yaksin [6, P. 211], the temporal function is provided by the simultaneous work of several analyzers, the movement and rhythm of life processes. The "mechanism" of time is based on the conditioned reflex activity of a person, which, with the help of exercises, forms a time reflex, or a sense of time. The daily rhythm of the organs of the human body has been confirmed by neurosciences. The biological "clock" in training should be aimed at the effective use of the natural forces of the body, its strengthening and increasing efficiency.

The pedagogical time and the educational activities that fill it correspond to the law of the scientific organization of labor formulated by K. Marx: “maximum efficiency with the minimum expenditure of time, effort and means” [7, P.47]. The problems of the scientific organization of labor in education were developed at the beginning of the 20th century. In the USA, individualized models of the organization of study time were developed: Howard-plan, Dalton-plan, Winnetka-plan, Batavia-plan, etc. In Russia P.P. Blonsky, N.K. Krupskaya, S.T.Shatsky, M.M. Pistrak and others made a great contribution to the development of ideas for the scientific organization of educational time in the early 1920s.

Thus, in pedagogy, time is considered as 1) a form of existence of pedagogical reality that optimizes the educational process, 2) the duration of pedagogical influence on the object of training, 3) a temporal characteristic of self-correction, 4) traditionally cyclical ways of organizing the educational process: the schedule of classes, calls for change, regulation of quarters, semesters, vacations, and school year.

The next direction of development of neurodidactics – methods of objective assessment of education-concerns the criteria for its assessment. Knowledge and competence approaches have vulnerabilities in addition to their strengths. Knowledge in its entirety is not always effectively used by people. Competencies are multiple, fractional, quickly outdated, and poorly diagnosed. The skills required by modern society to perceive and process information, solve situational problems, and learn continuously belong to the mental sphere. Researchers also wonder about the traces of education in the brain, or the differences between the brain of an educated person and an uneducated one.

This problem is related to the stimulation and training of cognitive and regulatory functions, which are the essence of the next little-studied direction. To date, the most mastered training based on biofeedback (biofeedback), in particular, training for the development of skills for regulating the General level of activation, attention and memory management. It is well known that cognitive and regulatory functions develop due to cognitive enrichment of the environment. Its information saturation leads to the growth of synaptic contacts at any age. However, there is still no conclusive evidence for determining the ability to learn by the density of synapses in brain tissue. Moreover, the neural network is subject to "editing", or resetting excessive synaptic contacts [1, P. 182].

A new and very promising direction is the introduction of artificial intelligence systems in training, which is based on the idea of equipping the didactic process with devices based on the Brain-Interface principle. These devices are able to select educational material (texts, tasks, tests, photos, videos) for each student, regardless of age. Routine cognitive functions of teachers will be replaced by intelligent robots.

The next highlighted area is the influence of sleep on learning and memory, research on which is conducted to a greater extent in neuroscience. Experts in this field have proven that the learning process is carried out around the clock. Sorting and integration of information received during wakefulness is also implemented in a dream. This is obviously related to the fact that automatic memorization of verbal information is performed more efficiently before going to bed. This method has not yet found wide application in pedagogy, but, without a doubt, needs to be developed.

The above-mentioned promising areas of neurodidactics development are constantly being supplemented due to the intensive development of this pedagogical branch. In their study, the alliance with other neuroscience is attractive, which ensures the success of the research search.

**BIBLIOGRAPHY**