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The formation of Neurodidactics in Russia

Abstract

The article presents an analytical review of the formation of neurodidactics in Russia. The retrospective of development of this branch of pedagogical knowledge is shown. The empirical basis is characterized, the main empirical provisions of neurodidactics are described. The article provides analysis of the theoretical base, including ideas, concepts, regularities in the field of cognitive and emotional spheres, consciousness and its functioning. The perspective directions of neurodidactics researches are allocated (the concept of lateral characteristics of a person, neuropsychological, neurophysiological specificity of students in the cognitive process, gender mindset, the temperament, the development of higher mental functions, sensory-perceptual organization of experience, compliance of the neuropsychological characteristics of the teacher and students).

Key words: neurodidactics, neuropedagogics, educational process, empirical and theoretical base, cognitive and emotional spheres, lateral features of a person.

1. Introduction

It is told in the Open letter of Association of experts in applied neurosciences that time in which we live is time of scientific revolution in the sphere of the sciences about a brain united under the general name of neurosciences (neuroscience) [1]. The validity of these words is confirmed by the following facts: scientific and research laboratories and institutes for neuroscience are organized and functioning in Russia and other countries of the world (Finland, France, the United States of America, the United Kingdom, and others). In the United States the presidential program "The Brain Map" is being implemented since 2013, the priority importance of which is equated to the cosmic exploration [2]. The international project "Brain and Learning" is being implemented, in which thirty countries take part. The project included representatives of neurobiology, sociology, medicine, psychology, pedagogy.

Integration of neuroscience with pedagogy has caused the growth of neuropedagogical knowledge, the isolation of neuropedagogy and the formation of neurodiadactics.

2. Materials and methods

The concept of "neurodidactics" (germ. neurodidaktik) was introduced in 1988 by G. Price. He identified a new scientific branch in the list of neurosciences, at the intersection of pedagogy and psychology. In determining neurodidactics, we adhere to the interpretation of O.V. Kulikova, who interprets this branch of pedagogical knowledge as "the study of ways of effective study based on the results of researches of the functioning of the structures of the brain and nervous system" [3].

Russian pedagogy has always been interested in the neuropsychological organization of a man. This fact is fully illustrated by the words of K. D. Ushinsky: "The relation in which the soul is put to a nervous body makes one of the greatest mysteries of creation which excites the strongest curiosity in the person, remaining the greatest riddle for him" [4]. In the fundamental scientific work "Pedagogical anthropology" the great Russian pedagogue revealed the psycho- and neurophysiological phenomenology of human study from the perspective of religious vision. We can only regret that the factors of mental activity of students developed by K.D. Ushinsky were not introduced by Soviet pedagogy into the pedagogical process.

In the twentieth century there was an increased interest in the Russian pedagogical community for neuroresearches. The scientific discoveries of A.R Luria, L.S Vygotsky in the development of higher mental functions, semantic and systematic cognition formed neuropsychological ideas about the functional activity of the brain in human study. The success of neuropsychological studies of psychologists B.V Zeygarnik, D.N Usnadze, B.G Ananiev, psychiatrists R.Ya. Golant, M.O. Gurevitch, A.S. Shmaryan, A.L. Abashev-Konstantinovsky, physiologists G.V Gershuni, N.A Bernshtein, P.K Anokhin, E.N Sokolov, N.P Bekhtereva, O.S Adrianov and others opened up broad prospects for the optimization of the didactic process.

In the 1990s, the authors of the first domestic developments in the field of neuropedagogy became T.V Akhutina, V.A Moskvin, N.V Moskvina, V.D Eremeeva, T.P Khrizman, A.S. Potapov, A.LSirotyuk. The prominent role in the development of neuropedagogy was played by the scientific works of V.G Stepanov, E.A Levanova, I.P Clemantovich, T.P Khrisman, A.S Potapova, K.A Mornova (constituting and topical problems of neuropedagogy in Russia), O.L Podlinyayeva, A.L Syrotyuk (neuropsychological features of students in the educational process), V.A Moskvin, N.V Moskvina, A.S Potapova (interhemispheric asymmetries and individual differences of people), T Kuzmina, VA Vorobyeva, NA Ivanova, EV Safronova, LI Serova (mental activity in the optimization of young schoolchildren), AA Malsagov (neurodidactics of adults).

At the beginning of the 21st century the Institute of Cognitive Neurology at Modern humanitarian academy became the launch pad of project neuropedagogical developments in Russia. It united scientists of MSU of M.V. Lomonosov, Institute of psychology of RAS, Institute of a brain of the person of RAS, Russian academy of education, scientific research institute of neurocybernetics and other research organizations for implementation of neuropedagogical researches.

The abovementioned allows us to present the picture of formation of neurodidactics in Russia by means of application of methods of systematization and generalization.

3. Results

The created empirical and theoretical bases actualize development of the perspective directions of neurodidactic researches in Russia. They include the concept of lateral features of the person (left-handedness, right-handedness) according to which partial domination of concrete brain zones defines existence of personal features in implementation of certain mental processes: thinking, memory, attention, emotions, will, etc. I.P. Pavlov distinguished left-brain, right-brain and equal-hemispheric types of functional asymmetry of hemispheres of a head brain [5]. The left hemisphere is responsible for short-term memory, logical thinking, verbally - sign information.

Owners of such qualities are called “thinkers”. The right hemisphere carries out operating function by emotions, figurative information, long-term memory. Such people are figuratively called “artists”.

Roger R. Hok has drawn an impressive conclusion: each hemisphere is a separate mind. People with a normal brain between hemispheres can have an incomplete interrelation. The potential of information processing increases twice at division of two hemispheres of a brain. Messages between hemispheres are necessary in order that “to put itself to the place of another” [6].

According to E.D. Homskaya, N.N. Privalova, E.V. Enikolopova there is an obviously expressed dependence between a profile laterality and characteristics of the highest mental functions: dynamics of intellectual activity, speed of sensorimotor reactions, emotionally-personal sphere [7].

At the same time, the facts received by E.G. Simernitska [8] have shown that it isn't necessary to be guided by the simplified representations, according to which one (speech) processes are carried out only by left hemisphere (at right-handed persons), while others (nonverbal) – only by the right hemisphere. All mental processes are difficult on their functional organization since they can be made at the different levels (unconscious and conscious, direct and mediated). Both hemispheres are closely interconnected. Their functions can vary in dependence on the task which is implemented by mental activity, its organizational structure.

So, the interhemispheric asymmetry of a brain, or multi-role participation of two hemispheres (left or right) in realization of mental functions, has partial, but not global expressiveness. In dependences on system, the nature of functional asymmetry can be differentiated. Interhemispheric asymmetry forms have different degree of expressiveness. Neuropsychologists (T.A. Dobrokhotova, N.N. Bragina, etc.) mark out the motor, touch, mental asymmetries which are divided into types. Considering variety of types of asymmetry, it is necessary to speak about strong or weak asymmetry.

The diagnostic methods directed to identification of neuropsychological features of students by the teacher are described in abovementioned works of A.S. Potapov and A.L. Sirotyuk. Domestic scientists (V.D. Yeremeyeva, T.P. Hrizman, etc.) offered theoretically reasonable, experimentally approved training models at the heart of which - lateral asymmetry of hemispheres of the brain. Ignoring specifics of manifestation of lateral features of a brain at students leads to negative consequences both in a didactic context, and in the context of health-saving.

The next direction of development of neurodidactics is account in training of neuropsychological and psychophysiological features of development, specifics of activity of women and men. Modern researchers (V.F. Bazarny [9], Yu.V.Baurova [10], Teltevsky N.B. [11]) insist on small efficiency of sexless pedagogics when identical forms, methods, receptions and content of training are used. Raising achievement at heterosexual students at separate training is noted. The need of implementation of gender focused education in the 21st century is emphasized in the Federal program “The Gender Strategy of the Russian Federation” (2004).

According to L.A. Alifanova, V.F. Bazarny, L.P. Ufimtseva, gender-oriented training has to become an alternative to sexless informational education. The last muffles natural emotional expressions and, as a result, values, meanings, requirements, motives, emotions, behavior, adequate to gender i.e.

Another direction of neurodidactics is account of temperament of students in knowledge (psychodynamic characteristics). Accounting by the teacher of the main

properties of temperament: activities (vigor, mobility), motility (speed and speed of motive reactions), emotionality (impressionability, sensitivity, uneasiness, impulsiveness), – raises the efficiency of educational process, promotes overcoming the communicative conflicts, creates success situation.

As an argument we will refer to the observations recorded by O.L. Podlinyaev, K.A. Mornov, A.A. Malsagov. The maximum time of the answer to a question doesn't exceed 6–7 seconds. However the phlegmatic person needs more amount of time – up to 10 seconds. Rigidity and the increased uneasiness level at the melancholic provoke confusion and "a cognitive stupor". The teacher should support emotionally melancholy people with peculiar to them external focus of control since they fall into a depression from the slightest negative manifestations of attendees. The natural emotionality, impulsiveness and hyperactivity of choleric and sanguine people often is mistakenly associated by teachers with bad manners, deviant manifestations.

The perspective vector of neurodidactics development is sensory-perceptive organization of experience (modality of internal experience). Sensory-perceptive organization of the person is the central channel of his informational perception. Psychologists allocate three types of a modality: audial (from lat. audio – to hear), visual (from lat. visualis – visual) and kinesthetic (from Greek. kinematos – movement). The called modalities in their unity characterize the sensory-perceptive organization of any person, however degree of their expressiveness differs.

The audio modality includes the internal experience of the inner world. It is determined by aural memory, correlating with memorization, preservation and reproduction of sounds in memory. People of this type are called "audials".

Visual modality concentrates the entire experience of the inner world, determined by sight. This type provides a visual memory, which is responsible for storing, preserving, reproducing of visible objects. People of this type are called "visuals", they demonstrate the overwhelming majority.

Kinesthetic modality concentrates the engine and the visceral experience of the inner world. Such a state of mind is a symbiosis of a motive, indivisible, indispensable, tasteful memory. Representatives of this type are "kinesthetics".

The next direction of neurodidactics is taking into account the level of development of higher mental functions. Accounting in the educational process of the individual dynamics of development of mental processes (memory, voluntary attention, imagination, thinking, speech, will, emotions) provides intellectual, cognitive and creative activity, speech and communication, self-regulation of students.

According to L.S. Vygotsky of [12], A.P. Luriya [13], the highest mental functions aren't given to the person in the finished form. They overcome a long heterochronic and asynchronous route of development, which determines the individual characteristics of training. Requirements of the teacher must correspond to extent of development of the brain of students. Late training finds problems in assimilation of knowledge since the highest mental functions are slowed down. Need of use of special forms, methods, the technics and the technologies aimed at the keeping development of the cognitive sphere of adults is explained by it.

This situation correlates with the subsequent direction of neurodidactics: compliance of neuromental features of the teacher and students. Styles of presenting of a training material by teachers have to correlate with style characteristics of perception and assimilation of educational information by students. The discrepancy between the individual profiles of the training and teaching personality provokes a

cognitive dissonance. In cooperation of students and the teacher important role play specific features of both. In particular, left hemisphere individuals are more inclined to the perception of rational influences, and right hemisphere - emotional, inspiring, since they are more conformal.

The relations between subjects of educational process have to be based on the person-centered approach based on trust to human nature and belief in ability of the constructive, responsible and free self-development provided by unique for everyone and unique biological system –the brain.

In the context of the directions outlined aboveit is appropriate to mention tendencies of neurodidactics of adults. One of them, according to A.A. Malsagov and V.V. Lezina [14], is the "supporting training" based on training of students for the solution of daily problems. Such training is mainly aimed at realization of a social way of life and activity of the person. Another tendency is foresight, forecasting in the course of cognition.

The allocated directions of neurodidactic researches and tendencies of neurodidactic training define "tomorrow" of domestic neurodidactics.

4. Discussion

Efforts of the Russian pedagogical community with assistance of scientists and researchers from other neurosciences have created empirical base of neurodidactics. As tools researchers use new noninvasive (without violation of integuments) means for a brain research. Their number includes the magnetic resonance imaging, the positionally-emissive tomography, the computer tomography. Thanks to them it became possible to investigate pedagogical process from a position of neurologic changes of a brain.

Empirical provisions of neurodidactics are formulated:

–The human brain is similar to "the parallel processor" since it is capable to carry out several functions at the same time in parallel. In this regard, students can be involved by the teacher in variable activity with the use of big set of the training methods. It should be taken into account hat both underload and overload of the brain have a negative impact on his functional state and the educational process.

–The brain of a person is capable to decompose and collect at the same time the new information, to operate whole and a part. In this regard, the analysis and synthesis as the most important interdependent processes in training demand a constant reinforcement by means of adequate pedagogical measures. The introduction of a training material must be in the mode of the analysis and synthesis, induction and deduction, a specification and generalization.

–Being natural mechanisms of brain development, teaching and learning represent the power-intensive physiological processes demanding from the student favorable hygienic conditions, qualitative food.

–The work of a brain is accompanied by correlation of subjective experience of the student with the task set for him. Understanding of the latter arises in case of updating by a brain of the competences which are available for the student. This process is disclosed by L.S. Vygotsky in the concept of a zone of relevant and next development.

–Processes of consciousness and subconsciousness in a brain of a student proceed at the same time. In the course of training a person obtains more information, than it is represented to him. Not only the words of the teacher, but also all factors of the

training environment have an impact on the trainee (internal: emotional condition, former experience, motivation, individual characteristics of the trainee; external: sound, light, the atmosphere in audience).

–Training of a person is productive if the activity of a brain is accompanied by establishment of regularities by means of overcoming intellectual difficulties. Productive activity of a brain is complicated by disorder, unsystematic character.

–The brain can perceive and process information in one stage at peripheral perception and the focused attention. At the relevant organization peripheral perception can become an effective factor of training.

–Emotions are an important factor of productive activity of a brain. They stimulate thinking and creative potential of the student. The emotional intelligence (EQ) is as important in training of adults as IQ.

–The systems of memory operated by a brain are visually-spatial and the one based on learning. The first is natural and the most preferable to brain activity. It figuratively represents the system of "bee honeycombs" which are filled with information and if necessary quickly taken from there. The second is artificial and labor-consuming in learning and reproduction. With age visual and spatial memory of the person weakens and is compensated by learning.

–Freedom of creativity is necessary for development of a brain; coercion renders the return influence. It blocks brain activity.

–The human brain is individual: each person has his own characteristics of information processing, this or that type of memory, specificity of thought processes.

–There are men's and female types of thinking. Due to simultaneous work of both cerebral hemispheres women show the best indicators in speech activity and communication; they use longer and compound sentences than men. The left hemisphere is responsible for verbal activity of men. They use the right hemisphere in work on abstract problems. As a result men quite often are owners of the so-called "mathematical mentality" that assumes operating by space, theoretical calculations.

–Both genetic factors, and hormones exert impact on the development of a brain.

The theoretical base of the Russian neurodidactics includes the ideas, concepts, regularities in the field of cognitive and emotional spheres, consciousnesses and its functioning.

To understand the essence of cognitive processes in learning, the theories of psychophysiological learning are significant (I.M. Sechenov, I.P. Pavlov, K. Hall); localizations of the highest mental functions of the person (A.R. Luriya);principle of dynamic variability of localization of such functions (I.N. Filimonov, U. Penfild, Lzh. Evans, G. Dzhasper); conceptual regulations on difficult lifetime formation of the called functions, their plasticity and reorganization under the influence of training (A.R. Luriya), about functional polysemy of brain structures (I.N. Filimonov), about an interiorization of external influences and an algorithm of intellectual actions (P.Ya. Galperin); the ideas about the high-quality change of the processes of knowledge determined by experience, embodied in a language picture of the world and other sign systems: instruments of labor, art objects (L.S. Vygotsky, A.R. Luriya), about lifetime change of the brain organization owing to change of the "interfunctional" relations (L.S. Vygotsky), about features of the individual neuropsychological organization of a brain and differences in cognitive styles (E.D. Homskaya, I.V. Yefimova, E.V. Budko, E.V. Enikolopova), about functional purpose of brain subcrustal structures in intellectual activity (N.P. Bekhtereva, M.N. Livanov (N.P. Bekhtereva); model of the organization and regulation of the behavioural act (P.K. Anokhin), etc.

Within the emotional aspect of learning got recognition the positions of the general theory of functional systems (P.K Anokhin, K.V Sudakov, etc.), the information approach (P.V Simonov, etc.), the activity approach (A.N. Leontiev, V.K.Vilyunas, O.Tikhomirov, etc.) and within its framework - the ideas of the unity of emotions and cognition (L.S. Vygotsky, L.I. Bozhovich).

The next aspect -the role of the consciousness in adult education- is embodied in neurodidactics to the principles of unity (interconnection and interdependence) of consciousness and activity (Leontiev), knowledge and experience (S. Rubinstein), consciousness and speech (LS Vygotsky), consciousness and language (Luria), the cultural-historical approach to consciousness (Luria), the question of the system and semantic structure of consciousness, its structure (Vygotsky, Luria, Leontiev, Zinchenko), the state of consciousness, its connection with human biological rhythms (G. Adler, M.V. Antropov), selfconsciousness, its correlation with motives (IM Sechenov, Z. Freud, V. James, A. Maslow).

5. The conclusions

Our analytical review of the formation of neurodidactics in Russia reflected the progressive dynamics of this branch of pedagogical knowledge. For incomplete three decades of its formation, the empirical and theoretical foundations of neurodidactics have been formed, ensuring the identification of promising areas of research and trends in neurodidactic education.

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