The article discloses how modern technology reconstructs latest pedagogical studies and transforms them. An interpenetration and an interaction with other humanities is the leading feature of the modern research, including that in pedagogy. Hence, the main methodological approach to pedagogical studies involves the notions of transdisciplinarity and integration. The authors review the modern pedagogical studies from the viewpoint of transdisciplinarity and integration; in this regard, modern versions of cognitivism, structuralism and connectivism should be referred to as the basic methodological approaches in the realm of the pedagogical research. Neuro-pedagogics is in the process of active development. It aims at determining the ways of increasing teaching effectiveness using the latest knowledge of human brain and mentality. But it is not yet quite clear how the data received can be transferred into the classroom: in what way the latest discoveries can be made useful to education, how to make knowledge in the sphere of neurosciences applicable to teachers, students, and much more to be considered.

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**Keywords:** Transdisciplinarity, interdisciplinarity, methodological and theoretical approach, neuroscience, cognitive neuroscience, neuro pedagogics.
1. Introduction

Methodological foundation and construction of a logical chain of the methodological research are the main approaches providing for scientific character of modern educational theories. In our context, a scientific approach is a sum of methods and techniques for studying the object with all its structural and functional peculiarities including all forms of interaction with the outer world. Methodological research is aimed at fruitful development and collaboration of different fields of research. The final aim is striving to substantiate new concepts, models and theories of instruction, to explain, prove, refuse or confirm the essence of pedagogical events.

Before we regard theoretical and methodological approaches, it is necessary to make clear what is meant by these terms in this research. A theoretical approach implies certain theories and concepts which based on, and a methodological approach demonstrates what methods and what methodological position the researcher makes use of in the course of his research (Tagunova et al., 2016, p. 5).

We may consider integrity and inter-disciplinarity (subjectness) as the most expressive approaches in the pedagogical researches. In the modern research the terms “multi-subjectness”, “inter-subjectness”, “poly-subjectness”, and “trans-disciplinarity” are not yet sufficiently differentiated and have no stable boundaries, so all these terms are sometimes used as synonyms. But they are still different. Usually interdisciplinarity is understood as the usage of methods, approaches, ways of thinking from different sciences for the sake of pedagogy. Today the pedagogics has strong interdisciplinary connections with sociology, psychology, philosophy, history, anatomy, biology, medicine, physiology, neurobiology, neurophysiology, neuropsychology, informatics, mathematics, ecology, culturology, etc.

The multidisciplinary (polydisciplinary) approach is based on the consideration of the integrated picture of the object under research, and different disciplinary pictures are looked on as different parts thereof. It should be mentioned that no transfer of research methods from one discipline to another, as a rule, takes place. From the point of view of multi-disciplinary approach, the human being should be considered as a complex object of a research that differs from others by some peculiarities (anatomical, physiological, psychological, etc.)

Transdisciplinarity is used as a “principle of scientific knowledge organisation”, which gives the way to possibilities of interaction of many disciplines while solving complex problems of nature and society. The transdisciplinary systemic approach makes use of the knowledge, formed and accumulated by disciplinary, interdisciplinary and multidisciplinary approaches. The transdisciplinarity as a methodological approach combines the unity of scientific and practical knowledge. Within the frame of this understanding: 1) transdisciplinary research necessarily affect the social sphere; 2) the most complex scientific problems are solved in an integrated manner with the help of a large number of sciences (Defila, Di Giulio, 1998).

2. Problem Statement

The understanding of the positive and negative effects of neuroplasticity helps one to come nearer to the realization of the limits of human abilities. In the course of numerous researches, it was determined that every student has a unique brain having specific characteristics, including the amount of information
to be processed, the speed of processing, a prevailing system of memory, the flexibility of mental processes, etc. Therefore in organising the process of learning it is very important to consider the students’ capabilities.

In 1988 Ellis and Young published their classic work “Human Cognitive Neuropsychology”. They laid the foundation of a theoretical approach, based on models and concepts from cognitive psychology (Ellis, Young, 2014). Cognitive theories of learning give a top priority to the fact that people actively process information and that education should be based on students’ effort. Internal mental processes include organization, storing, searching, keeping, and finding connections within information received. New information is connected with that already known.

3. Research Questions

In the era of postmodernism and IT, interdisciplinary connections of pedagogy are most brightly expressed with regard to neurosciences (neurobiology, neurophysiology, neuropsychology), which demonstrate “non-sensitivity” to the boundaries between different disciplines. Neuroscience is a field of science which studies nervous systems; in the context of neuro researches “neuroscience” is spoken of in the singular. Traditionally, it is considered a branch of biological sciences.

“The task of neural science is to explain behaviour in terms of the activities of the brain. How does the brain marshal its millions of individual nerve cells to produce behaviour, and how are these cells influenced by the environment...? The last frontier of the biological sciences is to understand the biological basis of consciousness and the mental processes, by which we perceive, act, learn, and remember” (Kandel, Schwartz, Jessell, 2000).

The rapid development of neural science has been assisted by the appearance of new instruments and technologies; among those: computer, magnetic resonance and positron emission tomography, which enable to examine the human nerve system (it was impossible until recently). Owing to the progress in the brain visualisation, it is possible at present to better understand thinking mechanisms going on in the head during instruction. It turned out that the brain picture (that on the tomography display) changes, depending on the action type: neuro chains reorganise themselves in such a way that they may carry on the task put forward most effectively. The scholars call this characteristic of the brain neuroplasticity. Neuro comes from “neurone”, a nerve cell, an assembly of which constitute the brain and the whole neuro system. Plasticity comes from changeability, liability to change. In the case of brain damage in connection with a trauma or disease, the functions of the damaged cells are performed by the other cells. If brain cells die, they can be replaced by others. Thus, the man’s brain structure changes throughout his lifetime. For example, the children with dyslexia cannot correlate sounds and letters; that’s why they experience serious difficulties while learning to read in a traditional way accepted at school. Man’s brain with dyslexia learns to process written information in an absolutely different way from that done by sane people. But such a person can learn to read in another way: looking into the text and listening to other people – parents or teachers - reading that text. Usually, in such a case the object put forward is not to gain success in reading letters or separate words, but to secure general understanding of the written text.

Studies in brain plasticity demonstrate that the main factor of success is in student’s behaviour, in student’s will and intention to study, to reach some result (Reverdy, 2012). But the brain neuroplasticity
brings not only benefits. Our most “hardened” habits are “the other side” of plasticity. The natural demand of the brain to work out patterns for easier processing information makes the brain be “lazy”. As ageing progresses, this problem increases becomes more and more difficult to make oneself carry out new actions, which would give the brain a “shake up” and pull it out from the state of an automatized life.

4. Purpose of the Study

The paper reviews the modern pedagogical studies from the viewpoint of transdisciplinarity and integration. Interpenetration and interaction with other humanities is the main feature of the modern research, including that in pedagogy. The modern versions of cognitivism, structuralism and connectivism are used as the basic methodological approaches for this purpose.

5. Research Methods

Modern versions of cognitivism and structuralism which develop in the context of new knowledge about the brain should be referred to the main theoretical approaches, used in pedagogical researches. Reliance on the related theoretical disciplines plays an exclusive role in all the areas of pedagogy and psychology (Tagunova et al., 2016, p. 8). Cognitivism (from the Latin “cognito” – knowledge, acquiring knowledge) is a doctrine of cognition which declares a possibility of acquiring knowledge about all mental processes and phenomena and believes that it is possible to describe them all by means of the logic of cognition. M.A. Lukatsky regards a cognitive approach in two aspects: 1) in developmental psychology as one of the approaches to studying human evolution in the context of its life; 2) in the psychology of acquiring individual experience as one of the psychological approaches to learning (Methodology landmarks of pedagogy, 2011). In the first case, the key to the child’s development is the formation of his cognitive, intellectual system. In the view of cognitively oriented scholars, unlike behaviorists, internal but not external factors prevail in the process of development. Accent on understanding a leading role of child’s inner sphere and understanding it as an intrinsic law-governed sphere, makes it possible to treat development as a sequence of successive stages. In the second case it is consciousness that finds itself in the focus of attention. It was understood about a century ago, in the period of an explosive development of science, when it was realized that it is impossible for an outside observer to study an object without influencing it. This is connected with the fact that external and internal spheres of a human being are closely connected. For carrying out this research the team use comparative analysis and classification.

6. Findings

Cognitive sciences use information from different branches of science and engineering, such as anthropology, psychology, neuroscience, philosophy, artificial intelligence, linguistics and so on. Known from the 1950-s, cognitive sciences now represent a very broad interdisciplinary area, its boundaries and degrees of interaction of the disciplines involved having been disputed till now (Wikipedia en François, 2017).
An important feature of research of the end of the 20th century has become a division between cognitive neuropsychology and cognitive neuroscience. Cognitive neuropsychologists devote a major attention to cognition; their colleagues are more interested in brain study, especially in functioning diverse sections of the brain. In the area of cognitive neuropsychology, scientists want to better understand the ways a person learns, cognizes reality and acts. Cognitive neuropsychology is the subject of psychology which combines biology and cognitive psychology. Unlike neuroscience, cognitive neuropsychology pays attention rather to intelligence, mind, than to brain (Tagunova et al., 2016, p. 145).

The appearance of connectivism – a theory for the digital age, is linked with the era of informational technology. Substantiating the necessity of its appearance Siemens points to the following tendencies in education: 1) an essential part is now played by informal education; 2) formal education is not so important as before; 3) modern education has many new forms, it is a continuous life-long process; 4) technologies change our mind; 5) instruments we use already form our mind; 6) attention to management of knowledge; 7) a necessity to connect personal and group education (Kandel, Schwartz, Jessell, 2000). Knowledge in connectivism is compared not only with the structure but also with the process. It is associated with a flood but not with a static structure where learning occurs by separate elements. Similar to system approach in education, students themselves construct different structures described by the nets. Learning process appears as an act in which nets are continuously forming and developing to which where students add yet more new knots (in a broader sense: people, journals, sites – all the sources of information) and connections are formed (Siemens, 2005, p. 81).

7. Discussion

The union of education theories and neurosciences has initiated “neuroscience education” or, as it is otherwise called, “neuropedagogy”. Neuropedagogy is a kind of a bridge between neuroscience and pedagogy. It is referred to applied neurosciences. The aim of neuropedagogy is to solve education problems in an optimum and effective way using knowledge of individual peculiarities of a person’s mental functions.

Neuropedagogy studies how it is possible to stimulate the student’s sense organs (eyesight, sense of smell, hearing, tactility), his/her emotional state so as to raise his learning capabilities and teach him to regulate his behaviour in the learning process. The effort of “neuroeducation” are aimed at understanding and realizing the act of learning, and suggesting technical and pedagogical tools, compatible with the brain functioning. This approach allows teachers to construct an informative field of education, to choose and accommodate diverse teaching strategies for the students to achieve success, and suggests discovering successful and defining unsuccessful teaching strategies; working out new strategies; broadening the field of comprehension so as “to become co-author to himself” (Les neurosciences au service de la pedagogie, 2016).

It has been found that a negative effect on child development is produced not only by overloading of a lesson with a learning material, but also by its underloading: the brain must work. As the capabilities of a child’s brain are great, and he/she is able to carry out a number of functions simultaneously, it follows that while teaching it is advisable to use a broad spectrum of various forms and methods of work giving students the broadest field of activity. An important feature of the infant age is an interest to
everything new, that’s why the teacher must organize a suitable learning environment and a comfortable emotional background to realize that interest (Tagunova et al., 2016, p. 24).

Neuroscience research has shown that men’s and woman’s brains differ. Taking it to consideration, it is necessary to speak to boys using short phrases, to draw them into an active process, to give them fewer written assignments, to praise them and give more chances to move, that they may overcome their aggression. Girls are fond of working in groups, they need to talk about emotions and look into their partners’ eyes. One should not raise his voice talking to them, but it is useful to get them help the teacher.

But the utmost assistance have neuropsychology and neurosciences rendered by now to inclusive education. In inclusive education, when it is necessary to construct individual learning routes, such an approach is very important. One needs to know what is exactly is necessary to develop and adjust to help a child to overcome not only today’s learning problems but also those of tomorrow.

The expertise accumulated by neuropsychologists in Russia testifies to the effectiveness of diagnostics and correction built upon the theoretical principles and practical work by Vygotsky – Luria’s school (Luria, 1969; Vygotsky, 1982). Nowadays child neuropsychology owns unique methodological equipment which allows to assess an individual style, specific features of the child’s cognitive functions development. The test procedure is supplemented by observation of the child at play, in class, also a minute study of his creative works. Such diagnostics makes it possible to see the child’s achievements and difficulties while acquiring the curriculum at school and at home and to be able to transfer the skills formed. Neuropsychological diagnostics allows to make prognoses as to appearance of possible difficulties in studying the programme, as it gives systematic knowledge of “weak” and “strong” aspects of the child’s mental development. It allows to construct adequate learning strategies and programmes of correction and development (Proceedings of the Second International MSPPU Conference, 2013).

Psychological and neurophysiological research has shown that certain physical movements influence the optimization of the brain activity. American psychologists P.E. Dennison and G.E. Dennison worked out the programme “Brain Gym”. The aim of the brain exercises was to overcome learning difficulties. But they may be used in any process of learning. The main idea on which Brain Gym is based is connection, interaction and mutual influence on one another of the three elements, namely brain, body and emotions. With the help of special exercises the organism coordinates the work of the left and right hemispheres and develops an interaction between the body and mind. Neuro-gym is a universal system of exercises which is effective for children who have problems in their development.

Every neuro-gym exercise helps to activate a certain area of the brain and starts the mechanism of joining together thought and movement. As a result of it, new learning material is comprehended as a whole and more naturally, as if by mind and body, and hence is better memorized. Besides brain exercises promote the development of coordination movement and psycho-physical functions.

Neuro-gym is also important for the elderly people. Neuro-science development has been a starting point for research connected with peculiarities for grown-up education. New methods for elderly people education have appeared. “Geronto-pedagogy” strives to guarantee these people a long and effective intellectual life: to be able to live for the sake of society and oneself (Dudko, 2016).

Human brain can acquire a capacity to learn and continue to develop in order to survive practically in any age. That’s why a key for the optimal functioning of all brain regions is to carry out more and more
new and different cognitive exercises. All people are unique individuals; the type of exercises for each person must differ from those for others. An ideal programme for mind training takes into consideration strong and weak points of a personality and constructs a complex of exercises, which are necessary for preserving the brain to be active and healthy (Gucher, 2012).

8. Conclusion

The problem of correlation of neurosciences and education has been at the top of the latest discussions among domestic and foreign specialists. A shock of new knowledge about images of the brain, 3D studies and diverse approaches, declared to be based on “brain-based” knowledge, arouse disputes about a possibility of applying the results of the latest neuro-science discoveries in the classroom. At present experts cannot exactly define what neurosciences really “contribute” to education. An essential question has not been solved: how to transfer experimental knowledge to school? Giordan, a Swiss educator and researcher, says that school education is still in a considerable degree “the question of tradition and empiricism” (Giordan, 2016).

Many achievements of neurosciences have not yet crossed classroom doors. Their practical realization is apt to failure/ Teachers and leaders of education do not have enough information about the latest achievements in the field, they speak of difficulties in mastering and realizing experimental data at school. And the researches themselves are not able to give unambiguous answers to all questions concerning the learning processes. It is well known that traditional forms of learning are not very effective, but there is not a common opinion that research findings in neurosciences must cause changes of the requirements and obligatory prescriptions in the sphere of education.

Besides, nowadays we witness a great amount of absolutely controversial experimental data. To duplicate such research is very difficult, because much depends on the researcher’s personality: they differ in the way they conduct their experiments.

Trans-disciplinary and poly-disciplinary studies make it possible to connect scientific and practical knowledge, to give a theoretical basis to ways and methods of education. All the time there appears new more and more complex instruments which can examine the minutest objects. But the problem is not to perceive each of 140 billion neurons, but to understand and explain what has been seen. Moreover, today the experiment proceeds this way and tomorrow – otherwise. In the end, much depends on the authority of the specialist concerned (Chernigovskaya, 2006).

Today an important stage of neuro-pedagogy development is to comprehend, analyze, interpret and adopt the inter-disciplinary data that we already have, to the realities of modern school, to apply it to the process of lifelong learning, which would enable people to discover their overt and potential abilities and use them more effectively for their own sake and for the sake of social development.

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