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Features of Information and Communication Technologies in the Educational Process: Neuroscience in Education

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Abstract: *Society is intensively developing in the context of informatization and the use of innovative technologies, which causes the need for changes in various spheres of life and relevant social institutions. Such a trend determined the relevance of the research problem, in particular, a hypothesis was formed about the effectiveness of neuropedagogical and information and communication technologies as a factor in reforming modern education. The purpose of the research is the role of neuropedagogy in modern, the effectiveness of informatization as a reforming factor. The tasks of the research are aimed at determining the aspects of the effectiveness of the application of innovative and neuropedagogical technologies in the educational process, in particular, the neuroscientific aspect and the computer as a set of innovative technologies. The article characterizes the categorical and conceptual context of the educational trends of the modern information society, which is in the process of formation and reformation. In order to determine the specifics of the research problem, the theoretical and methodological foundations of scientific publications in the relevant field were analyzed. The concepts of neuropedagogical technologies, reforming modern education, computerization of education are summarized, methodological technologies of the educational process are analyzed in the context of neuroscientific technologies. In the course of the study, the method of abstraction, descriptive and research method, method of analysis and synthesis was applied.*

Keywords: *Educational process, neuropedagogy, ICT technologies, digital transformation, quality of education, competencies.*

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Introduction

The transformation of information technologies covers various spheres of life in the period of the information society. Such a transformation is revolutionary in the conditions of the current development of people's lives. Thus, digital transformation is aimed at interpreting various spheres of life into the information space. The impact of digital transformation is especially intense in the field of education. Neurophysiological personality factors are an important aspect of the use of information and communication in educational activities, which leads to the study of neuropedagogical technologies.

The progress of society today takes place in the conditions of globalization, the development of innovative technologies and the formation of an information society. In order to ensure progress, it is necessary to promote the formation of competence, which will be relevant in further social development, in particular, priority should be given to education and science. Accordingly, society and the state determine the main task - to introduce such educational conditions that will solve various problems in the process of progress (Bibik, 2002). Informatization of society is a factor in the transformation of the interaction of various objects from a physical environment to a virtual one, which significantly affects the educational process.

Today's education process needs updating and radical changes, as society is in the process of informatization and intensive use of innovative society, which is the source of global collisions. Such a trend determined the relevance of the problem and became the basis for conducting the study. Education contributes to intensive economic and political development, and also determines the digital environment in which the educational process takes place (Vdovych, 2013). Since, in today's conditions, the informatization of society has become a widespread phenomenon, that is, various socio-economic and political factors are interconnected, the main task of which is to create conditions for meeting information needs in various spheres of activity, the problem of researching various aspects of the use of innovative technologies is relevant in the context of education reform.

The development of pedagogical science in the information society is in demand in connection with the enrichment of pedagogy with new methods, forms and technologies. One of these areas is neuroscience. Neuroscience is a branch of science that studies the chemical, biological, and anatomical features that affect the brain and nervous system. The interest of education in neurotechnologies is related to the possibility of

individualization of the educational process and personification of educational technologies. On the one hand, based on extensive experience in studying the brain, they help to record the current state of the student (emotional and physiological), practically without affecting him. On the other hand, they allow you to develop cognitive functions. The study presents an analysis of the history of neuroscience, its main milestones and achievements, which are aimed at the development of neuropedagogy as one of the modern directions of the development of pedagogical education. It is based on the interaction of pedagogy, psychology and neuroscience to study pedagogical processes from the point of view of brain response. This direction is actively developing all over the world, the main methods of neuroscience are considered, one of which is the electroencephalogram, which allows recording the bioelectrical activity of the brain and its interpretation according to the state of the person (meditation, concentration, etc.). The development of this direction can help modern teachers in the individualization of the educational process, psychological work with children, and student motivation.

The purpose of the article is to investigate the peculiarities of the introduction of neuropedagogical technologies in the process of informational and communicative learning during the reform of modern education.

Neuropedagogical technologies as an effective factor in the formation of quality education

Neuroscientific learning technologies are a combination of research work on the study of the nervous system and the development of science in this aspect (Woodruff, 2011). Neuroscientific learning technologies contain the main approaches to studying the interaction of biological and psychological processes of human life. Thus, the effective technologies of neuroscience are the method of biological feedback, which evaluates and trains the cognitive abilities of an individual. Based on neuroscientific technologies, an educator can determine the factors of personality formation, and can also correct human behavior thanks to appropriate training technologies, which are also effective in the conditions of modernized reformed education. Neuropedagogical technologies contribute to the effective determination of pedagogical approaches to achieve the goal in the conditions of the implementation of the goals of the educational process, in particular, contribute to obtaining objective information about the emotional state of students.

In the conditions of the new digital economy, teacher education cannot work according to the old model and with the same efficiency, using traditional processes, methods, educational technologies and tools. One of the promising areas of education development is the assessment of education and educational materials at the level of human biological signals (brain activity), which allows monitoring the direct reaction of the organism to various learning conditions. Similar to the cardiogram, it is possible to judge the activity of the brain with the help of methods of recording fluctuations of the electrical potential on the surface of the head (electroencephalogram).

Interest in the considered scientific direction arose at the end of the 20th century, when the methods of measuring brain activity were widely developed in the field of neurobiology and considerable experience in its study was accumulated, primarily in such fields as neurobiology, neurophysiology, neuropsychology, etc. It is at this time that a new stage in the development of neurobiology takes place. In order to reveal the pedagogical potential of neurotechnologies, the origin of this direction and their connection with educational activities should be considered. If we consider neuroscience as a separate field, then it is a scientific field that studies the chemical, biological and anatomical features that affect the activity of the brain and nervous system. However, more and more often, neuroscience is considered as a field that, having a scientific basis for studying the brain (knowledge, research, methods), is able to integrate into various fields of science and is a concept that combines various interdisciplinary fields of activity of other sciences (psychology, medicine, biology, chemistry , physics, etc.).

Very often, neuroscience and neurobiology are considered as two synonymous concepts, but this is not entirely true. The primary focus of neurobiology is the study of the functions of the nervous system, including mediating behavior, while neuroscience studies the structure and function of the brain and nervous system.

Work continued with data on the electrical activity of the brain, new rhythms were discovered (delta, gamma, theta, delta), EEG began to be actively used in medicine to diagnose brain diseases. In addition to the discovery of new rhythms, there were works on the possibility of forced strengthening of brain centers and conscious regulation of brain rhythms, on active rhythms of the sensorimotor cortex, as well as many other studies, which ultimately led to the appearance of the term "brain-computer interface" interface), which allows you to control devices using brain activity.

In the arsenal of neuroscience, there are many methods and technologies that are typical and were used mainly in medicine and neuroscience, but now they are also used in other areas, including neuropedagogical research:

- Magnetoencephalography (MEG). It does not register the electric pulses themselves, but the magnetic field they create. For this, it is not even necessary to attach anything to the head - all the necessary sensors are inside the "helmet", which is worn on the head of the examinee. The method is accurate, but very expensive – it is rare that a research center can afford the equipment for it. In addition, MEG systems cannot be transported and are not suitable for research, for example, in school classrooms.

- Magnetic resonance imaging (MRI). Allows you to obtain images of internal organs using the phenomenon of nuclear magnetic resonance. For this, the nuclei of hydrogen atoms are excited by electromagnetic waves of a frequency that is safe for the body (there are a lot of them in the human body - in the composition of water and not only), and then the energy released is recorded in the nuclei.

- Transcranial dopplerography. Ultrasound examination of cerebral vessels. The brain is almost completely covered by dense and thick bones of the skull, there are only a few "windows of transparency". Ultrasonic probes are sent to them. Like MRI, transcranial dopplerography has a functional option. With its help, you can find out how the blood flow in the brain changes during various types of action laziness Ultrasound equipment is not as bulky as MRI scanners or MEG systems, but is also only used in a laboratory setting.

- Eye tracking or oculography. A technology that tracks eye movements and allows you to trace the sequence with which the observer's eyes fix different parts of the object under consideration. This direction is actively used in marketing, the study of purchasing power, in the design of various electronic resources (sites, games, applications, etc.), as well as recently in educational activities.

- Electroencephalography (EEG). This is a recording of the brain's electrical activity using electrodes attached to the scalp. In recent years, portable EEGs have been greatly developed - subjects can move and behave more naturally with them. The method allows you to record changes in the brain almost in real time, but has a low spatial resolution, that is, according to the EEG data, you can say exactly when brain activity changed, but only approximately determine at what moment it happened.

Alpha, beta, gamma, theta and delta waves can be recorded using EEG, recoded into an accessible form, for example, into indicators such as

attention, mood, concentration, enthusiasm, cognitive and emotional load, etc. This is one of the most accessible methods that is actively used in neuropedagogy. .

Neurotechnologies in pedagogical science began to be used relatively recently. It all started in 1988, when a new term was defined - "neurodiactics", aimed at denoting an interdisciplinary field that exists at the border of neuroscience, pedagogy and psychology, in the framework of which the issues of organizing conditions for effective learning are considered, based on the results, research on the functioning of the structures of the main brain and nervous system.

Therefore, the latest technologies, in particular neuro-pedagogical ones in educational activities, are effective in determining the basic needs of a modernized society in conditions of intensive development of computerization.

Features of information and communication technologies in the educational process

The latest technologies are the main factor of changes in social development aimed at realizing the rights and responsibilities of citizens in the use of information resources for the realization of personality in life. It is important to study the importance of information and communication technologies in the process of obtaining an education and developing skills and abilities in the formation of competence (Virna, 2017). It is the value orientations that form the spiritual and moral world of humanity, which determine the further future.

The professional activity of a teacher as a bearer of spirituality and morality is formed in the process of obtaining an education and establishing a personality capable of self-realization and self-development. The teacher determines the methodology and technology of his professional activity in accordance with the talents and abilities of the children. The main goals of obtaining an education are the development of competence and the formation of value orientations. In the conditions of informatization of society, new challenges appear before the participants of the educational process (Kovaleva, 2019). Innovative technologies in education are the result of the achievement of evolutionary development of humanity and, at the same time, are the cause of further civilizational progress. A feature of the innovation is its ability to improve the professional competence of the teacher and to form an effective educational environment in the educational institution. Innovations involve the implementation of appropriate activities

that improve the opportunities and abilities of those seeking education and improve the field of activity.

One of the effective manifestations of innovative activity is the source of such work, which consists in the constant search for ideas in order to solve a problem by the method of testing and approbation. Pedagogical experiments or pilot projects are expected to introduce innovation into the educational process. The further development of innovations in the educational process depends on the need for new ideas and their implementation.

Research centers, laboratories, and educational institutions are being created around the world, aimed at conducting neuropedagogical research and introducing it into the educational process:

- Center for Educational Neuroscience in London;
- Institute of Cognitive Neuroscience of the Modern Humanitarian Academy;
- Institute of Cognitive Sciences, etc.

Various experiments are being conducted in the field of face-to-face learning, for example, "Group-a-Ware" is a prototype system "that monitors the learning process and the state of the student, analyzes emotions and cognitive processes and provides feedback in real time. In Group-a -Ware, with the help of a neuro-headset and biometric bracelets, streams of data are recorded and indices are calculated from them, corresponding to various aspects and characteristics of cognitive load, various psychophysiological indicators that indicate how the educational process is. These data are processed in real time and provided to the teacher along with recommendations so that he can adjust the training program. Likewise, each listener receives personal feedback for self-control. This happens both during the process and after the fact in the form of a report. The novelty of the ongoing research consists in a unique comprehensive evaluation of the effectiveness of video lectures and educational materials in the framework of electronic learning using neurotechnologies: neurointerfaces (tracking and interpretation of brain activity, EEG) and oculography (tracking eye movements and concentration on certain objects).

Thus, the latest technologies in education are the process of formation and implementation in practical activity of new ideas, technologies, tools for solving pedagogical tasks that increase the level and quality of education (Kolomiets, 2007). Informatization absorbs the spheres of human work, transforms the results of human achievements into a virtual environment. Such trends cause a change in social development and require new knowledge and skills. Therefore, the education of the present and the

future needs reorientation to the latest achievements, corresponding changes are possible only with the effective implementation of the latest technologies.

Development is one of the most important areas of human activity (Kudykina, 2003). This process can be applied in various spheres of human activity, including pedagogical ones. Scientific and technical progress contributes to the fact that pedagogy opens up more efficient, effective ways of changing an ordinary person into a socially developed personality. An important feature now is the revitalization of educational innovation processes, that is, the introduction of the latest technologies into the educational process. The result is a replacement of the paradigm of education: a different content, new approaches, opportunities, emotional experiences, behavior, innovative perception of the world in pedagogical activity are recommended. Contradictions between the educational system and the requirements of socio-economic development of society lead to the need for innovative transformations (Lazurenko, 2015). In the context of changes, digitalization of the economy, the issue of introducing innovative technologies into all spheres of human activity, including pedagogy, is the most urgent. In pedagogy, an innovative direction was formed - the theory of innovations and innovative processes. Changes in education are considered as innovations aimed at improving pedagogical activities, development and self-development of educational institutions and ways of managing them.

The introduction of the latest technologies is based on scientific achievements and technologies that contribute to the implementation of the main task highlighted in modern scientific research. According to the researchers, innovations in education involve the advance training of highly qualified employees for the scientific and technical sphere and science-intensive fields of activity and their further implementation in life.

The introduction and use of pedagogical innovations is an indispensable condition for improving the quality of education and the competitiveness of an educational institution in the market of educational services. For example, Mashovets M. A. (2017) grouped and characterized those innovative technologies of obtaining education that he had to face on his own experience: cases, discussions, colloquiums, e-mail communication, rating control of knowledge, etc. Researchers Nychkalo, N.G. (2008), Sikorska, I.M. (2006) pay attention to the latest technologies such as collaborative learning, the principle of pedagogical support in learning, etc. Lazurenko (2015) considers the problem of studying the mechanisms of introducing the latest methods of teaching and education into the modern

education system, since teachers often face problems related to the failure of innovative models and the return to traditional technologies (Nychkalo, 2008). The researcher emphasizes the need to study and use modern educational technologies based on methodological approaches: systemic, axiological, humanistic, personal-activity, etc. The emergence of innovative technologies in education is associated with the introduction of experimental pedagogy on the study of the psychological development of students, the search for new forms and content of education.

One of the manifestations of innovative education and an example of the use of the latest technologies in the educational process is the introduction of distance education, which has become an important alternative to the educational process during the quarantine period. Distance education involves the use of ICT technologies, that is, a computer in combination with Internet resources (Anderson et al., 2006). Such education is a promising alternative that is effective in the conditions of integration, globalization and informatization of the educational process.

The essence of education is constant updating and improvement, which makes it effective and, accordingly, realizes its main goals. Domestic and foreign researchers claim that the task of education as a process consists in choosing the priority of renewal and reform.

The most recent historical era is marked by the rapid pace of development and inten sive use of information and communication technologies in human life. It can be argued that human life is undeniably connected with the computer in the conditions of the latest social development. That is, the factor of social progress is the efficiency of computer use. Informatization absorbed all spheres of human activity and determined the processes of digital transformation of social development. This trend causes the use of the latest technologies in the educational process, which is one of the most important factors in improving the well-being of mankind (Oman et al., 2008). Modern researchers associate the informatization of the educational process with the inclusion of computer technologies in the educational process as a means of teaching, educating and developing schoolchildren, as well as means of ensuring the professional activity of the teacher (Ratanasiripong et al., 2012). The problem of intelligent selection of educational tools based on information technologies is very acute. Information technologies fit succinctly into the functional theory of education.

The essence of the activity approach is to determine the main elements of the learning process, to separate its structure and to organize on

this basis the most effective activity of the teacher and the student of education.

The need for computerization of the educational process, as an independent scientific and practical problem, is due to the peculiarities of the organization of the education process, the need to take into account the age and psychological-pedagogical differences of students. Today, in the era of computerization, teachers must prepare an information-literate and independent personality, that is, one of the defining goals of education is the formation of informative competence, which was introduced as a result of reforming education according to the Concept of the National Academy of Sciences (Salam & Abdul Wahab, 2008). Therefore, in the conditions of intensive development of information and communication technologies, the computer should be effectively used to ensure the quality and level of education determined by state standards in the process of modernization and reform of education.

Peculiarities of modern education reform

State building in today's world is formed in the context of integration and globalization, which is the reason for the introduction of the latest changes in socio-political and economic development. In accordance with the need for such changes at the state level, it is necessary to introduce reformation processes that contribute to the achievement of high world standards (Cacioppo & Bernston, 2005). Thus, the National Doctrine of Education Development, which determines the course of the state educational paradigm and creates opportunities for competition in the European environment, is important for the implementation of reforms in education. The doctrine determines the priority areas of educational activity, the result of which will be the formation of a competent person who is able to be a competitive specialist in the professional environment and a formed person who has universal value orientations (Camerer et al., 2005). According to the tasks of the strategy, the student of education should be mobile in the labor market, able to make the right worldview choice with universal moral values, possess knowledge and skills, appropriate competences for self-development throughout life.

Reforming education causes progress in the acquisition of personal competence and contributes to the improvement of self-realization. Accordingly, an educated person will more effectively use his abilities, knowledge, skills to achieve well-being in his own life, which will lead to the improvement of the economic development of society as a whole.

In the context of interaction between man and society, the main tasks for further progress are formed (Gygli et al., 2019). Such interaction should be effective, and, therefore, involves a certain algorithm of actions that will contribute to the development of the individual in society and vice versa - the influence of society on the development of the individual. There is a need for a detailed analysis of education problems and a search for a mechanism for solving the relevant problems. The result of such activities determines the principle of a modernized policy, which provides equal access to obtaining quality education, the introduction of the appropriate management process and the content of education.

Therefore, on the basis of the analysis of the educational process, there is a need to introduce effective educational activities in the conditions of modern challenges of social development (Giddens, 1991). The discussion of the concept of reforming domestic education in the period allows us to conclude that different groups of the population understand the goals and purposes of education in completely different ways, and these different views and approaches to education require special identification, conceptual expression and discussion. The analysis of the literature made it possible to identify three main strategies in the development of the educational system: national, liberal-humanistic, socio-cultural and technological.

The national strategy is aimed at maintaining the highest possible level of general secondary education, which involves ensuring the quality and level of education (Imel, S., 1998). At the same time, education policy is subordinated to the task of development of a specific personality and social groups of the population based on the payment of quality educational services - the most important condition for a high quality of life.

The socio-cultural and technological strategy emphasizes the need to develop a high level of general secondary education as the most important condition for the development of modern forms of work organization and support for organizational and educational initiatives and projects that ensure the realization of the main goals - the formation of competence (Javor et al., 2013). However, beyond the mutual recognition of each other as subjects of educational reform and development, behind the interrelationship of these points of view, there is a set of mutually contradictory positions on the priority directions of educational development.

In those determinations of the content of education, it is necessary to be guided by the general orientation of preserving a single educational space. It is important to regulate the process of building the content of education based on uniform educational standards, which determine the main educational standards (McDermott, 2004). In the conditions of growing

methods of application and use of information technologies, it is necessary to strengthen the role of educational programs that promote independent work with a computer, assimilation of information technologies (Gray, 2008). It is necessary to form a new content of education, which will form metacognitive environments and metasubjects (Smith&Schwartz, 1997).

Another important aspect of education reform is the implementation of neuropedagogical technologies as an effective tool for achieving education standards. So, a start-up is being introduced that creates neural interfaces and neural data processing algorithms, develops neurotechnology and creates products based on brain-computer interfaces for education, entertainment, industry, medicine and personal use in similar research. Using VR in conjunction with neural interfaces "allows educators to gain additional information about students' responses to learning content. So this is a very promising idea: you can create perfect educational scenarios."

From the point of view of the interaction of sciences, pedagogical neuroscience or neuropedagogy is "a scientific direction that combines cognitive science, neuroscience, educational psychology, methodology, didactics and other related disciplines to study the relationship between physiological processes of the brain and learning. If we consider the term by its functional component, then "neuropedagogy is an applied neuroscience that uses knowledge of cognitive neurology.

Thus, the reformation of education involves the introduction of changes that will contribute to the more effective development of a modern competitive personality, which is capable of self-realization and ensuring personal well-being in the conditions of informatization and progressive progress of society. Reforming education involves the effective use of the latest technologies as one of the most important factors in raising the level and quality of education, and, accordingly, improving social development.

Conclusions

The conducted research proved that in conditions of intensive development of information and communication technologies, it is necessary to introduce the latest technologies into the educational process and to single out the most effective approaches. In order to increase efficiency, the educational process should be reformed in accordance with the modernized needs of modern society. Based on the research of scientific intelligence, an analysis of the main results was carried out and it was determined that:

1) the latest technologies are an effective factor in improving the quality of education;

2) the introduction of the latest technologies into the educational process can be effective in the conditions of reform;

3) the most effective new technologies are information and communication and neuroscientific technologies;

4) the computer is a defining element of the educational paradigm change in recent history.

In the course of the research, the theoretical and methodological aspects were analyzed and the definition of the main concepts of the research was formulated. The progressive opinions of scientists regarding the results of the research are analyzed. The aspects that determine the main context of reforming the educational process are formulated. It has been established that reforming education is necessary to adapt the latest technologies and meet public needs in conditions of intensive informatization and computerization of social development.

The results of the research do not exhaust the full context, however, clarify the meaning of the latest technologies in the process of becoming a person capable of realizing his knowledge and skills in the conditions of intensive development of computer technologies.

Thus, pedagogical neuroscience or neuropedagogy today is a promising direction of education development, which is proven in the course of the analysis of the literature and ongoing research.

The development of neurotechnologies in educational activities can allow to look at the learning process from the point of view of the listener's brain (processes that occur during learning), without actually interfering with the learning process and without affecting the student, which is quite objective. On this basis, you can try to build a personality.

Aknowlegment

Author 1 analyzed the works of prominent scientists on this problem and formulated the main research methods

Author 2 analyzed the conceptual provisions of the introduction of new technologies into the educational process, defined the main context of education reform

Author 3 created the main requirements for the research context on the basis of scientific publications and outlined the essence of the main concepts of the research.

Author 4 researched and created a list of literature on this problem.

Author 5 formed the main structural components of the research work

Author 6 systematized the list of literature of world researchers.

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