



# Individual Features in Teaching Pedagogical University Students Using Neurobiology Methods

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## Abstract

The article presents some conclusions of the use of neuroscience achievements based on a number of neurophysiological criteria in pedagogical university students in the process of adaptation to learning. These conclusions were obtained in the course of work on the grant «Fundamental study of individual differences in learning among students and schoolchildren using methods of neuroscience and big data technologies» No. 073-03-2021-020/2 of the Ministry of Education of the Russian Federation. The study revealed the influence of individual differences in students' learning, and the importance of neurophysiological criteria in the formation of students' adaptation to university education using neuroscience methods and big data technologies. Neurophysiological criteria reflecting the characteristics of the functional state of the central nervous system are identified and substantiated in the work. It is recommended to determine the neurophysiological type of students taking into account the individual characteristics of learning and determining the methods of adaptation of students of a pedagogical university. For students acquiring professional skills in higher educational institutions, rapid and comfortable adaptation in the educational environment of the university is one of the factors affecting the quality of education and the level of training. In this regard, the use of achievements of neuroscience is relevant. The paper examines the influence of the information and psychological load on the functional state of the central nervous system of pedagogical university students in order to take into account individual characteristics when selecting methods of adaptation to higher education.

**Keywords:** neuroeducation, higher education, individual differences, brain-based learning.

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## Introduction

Modern Russian society is focused on dynamic economic and social development, the most important factor in the development of which is education, the basis of which is the teacher's possession of professional competencies. The quality of professional training of future teachers is associated with the modern educational technologies used to assimilate educational information. It is this activity that is very difficult for modern students, especially now, when the information space is oversaturated with a variety of information.

The value of knowledge has been dominant in higher education for a long time. This leads to predominance in the training of university graduates of activities for the development of their cognitive abilities. The transition to federal state educational standards was associated with the demand on the market for those young professionals who should be ready for professional activity in the information society. This is facilitated by the active introduction of digital devices and integrated digital technologies into the educational space of the university, which makes it possible to partially optimize the educational process, control the time, place, educational trajectory, and pace of educational activity. Neuroeducation (brain-based learning) plays a huge role in this process, which is designed to improve the educational process and improve the quality of professional training.

Neuroeducation is an interdisciplinary field of scientific knowledge that combines the results of studies of the brain and the mechanisms of its functioning in order to find the most effective principles and methods of organizing the educational process [10].

Neuroeducation as a separate approach [7] presupposes the presence of theoretical and methodological foundations that describe the individual's learning process at different analytical levels: genetic,

neural/physiological, cognitive / behavioral, phenomenological (student's experience in self-reports) and socio-cultural (socio-cultural context in relation to the educational process).

At the same time, the emphasis is not on any one, as is often the case with the neurobiological level, with which many scientists initially tried to explain the mechanisms of learning. We are talking about an integrated approach, the integration of knowledge from different sciences [10] of equal value: only their joint accounting will help to develop a unique methodology of neuroeducation. In particular, it is important not only to study the psychophysiological and behavioral aspects of learning, but also to consider them in the context of the educational process, that is, the conditions of social interaction in the learning process [13].

The relevance of the problem of neurodynamic determinacy of individual differences in the cognitive activity of students is determined by one of the most important tasks of the modern educational system – the search for ways to improve the effectiveness of learning. The study of psychophysiological patterns in the formation of individual variations of cognitive activity of students at various stages of ontogenesis is a condition for solving the problems of developing innovative technologies to improve the quality of the educational process.

Numerous works are devoted to the study of the individualization of the educational process, taking into account stable neurodynamic peculiarities and the nature of psychophysiological states, as one of the fundamental conditions for improving the effectiveness and quality of educational interaction [1; 10; 17].

It is known that the transition in the learning process from school to university follows the next stage of individual development (or critical period), the greatest sensitivity to environmental factors (there is a change in the educational

and social environment); such periods (stages) are called sensitive periods. Therefore, at this time there is significant functional overstrain caused by the restructuring in the activity of the main physiological systems, associated with low and unstable performance, accompanied by a decrease in mental and physical activity [8].

It should be noted that the beginning of studies at the university, as well as the period of puberty (11-15 years), are the most difficult stages in the student's life, not only physiologically, but also socially and psychologically.

In psychology, social adaptation is understood as a constant process of active adaptation of an individual to the conditions of the social environment, and the result of this process. In other words, «adaptive ability refers to a person's ability to adapt to various environmental requirements (both social and physical) without feeling internal discomfort and without conflict with the environment» [15, p. 12].

Adaptation is a prerequisite for active activity and a necessary condition for its effectiveness [5].

In the studies of various authors, three forms of adaptation of first-year students to the conditions of the university are distinguished:

1) formal adaptation, concerning the cognitive and informational adaptation of students to a new environment, to the structure of higher education, to the content of education in it, its requirements, to their duties;

2) social adaptation, i.e., the process of internal integration (unification) of groups of first-year students, and the integration of these same groups with the student environment as a whole;

3) didactic adaptation concerning the preparation of students for new forms and methods of academic work in higher education [2; 5; 17; 18].

In addition, the first-year students are influenced by the restructuring and introduction into the educational environment, when there are many new and specialized subjects, a new system for submitting educational material, the active use of new digital technologies of the university, which cannot but affect mental performance. A person's mental performance depends on many factors, the totality of which can be divided into three main groups: physiological factors – age, gender, level of physical and functional development, state of health and nutrition; physical factors reflecting geographical, climatic conditions of existence; mental factors are: motivation of activity, emotional mood, etc. All of these simultaneously affect the body and mutually condition each other.

All of the above factors influence the adaptation of first-year students to the educational environment of the university.

### **Methodology**

It is necessary to study the state of anxiety of first-year students in the conditions of higher education, for their adaptation to the content and organization of the educational process in a new educational institution. It is known that the increased level of anxiety of students negatively affects the functional state of the central nervous system and the body as a whole. Repeated experience of anxiety can cause high sensitivity to stress, difficulties in intellectual activity in stressful situations, somatic and neuropsychiatric abnormalities [3].

The effectiveness of students' adaptation to the learning process in higher education institutions depends on many factors. These, along with individual characteristics, include the integral characteristics of the nervous central system (the strength of nervous processes, the level of functional mobility of nervous processes). These parameters are among the leading ones that determine the effectiveness of any activity, especially cognitive. And to identify indicators that

determine the success of the development of educational programs in the context of the implementation of federal state educational standards, the influence of the functional state of the nervous system on cognitive activity..

When characterizing the properties of nervous processes, functional mobility is important, reflecting the dynamics of cortical processes, the speed of information processing and the effectiveness of integrative brain activity. Functional mobility of nervous processes characterizes for a particular individual the level of performance of work, which provides, along with positive reactions, emergency switching of actions, rapid alternation of excitatory and inhibitory processes. This property does not contradict the concept of lability, although it differs from it, since it represents a high-speed reaction of a functioning functional system, and not a specific nervous substrate, reflects the ability of the nervous system to perform a certain number of working cycles per unit of time under the action of positive and inhibitory signals [3].

The indicators characterizing the mobility of the nervous system include a simple visual-motor reaction (PMR), a complex visual-motor reaction «Choice reaction» (SPMR) and a tapping test, which we evaluated in 1st-year students using the hardware and software complex «NS-Psychotest» («NeuroSoft», Russia, Certificate of Conformity No. ROSS RU.IM18.D00567). The current functional state of the central nervous system (CNS) was determined by the criteria of T.D. Loskutova: the functional level of the system (FUS), the stability of the reaction (UR), the level of functionality (UVB) [16].

The time of a simple visual-motor reaction is an integral indicator of the rate of excitation through various elements of the reflex arc. However, the main role is played by the excitation of central structures, which, according to a number of authors [4; 9], allows us to consider the time of PZMR as a criterion of excitability and lability of the central nervous system, a sufficiently

adequate indicator of the functional state of the nervous system. [3].

The strength of nervous processes is an indicator of the efficiency of nerve cells and the nervous system as a whole. A strong nervous system can withstand a greater load in magnitude and duration than a weak one.

As an integral indicator of the functional state of the central nervous system, P.A. Baiguzhin and D.Z. Shibkova consider the time of an arbitrary reaction [19]. M.P. Moroz for this purpose suggests considering the dynamic characteristics of the time of a simple visual-motor reaction (variational chronoreflexometry). The speed of sensorimotor response reflects the main properties of the nervous system, in particular, excitability, reactivity and lability [14]. In the context of educational and professional activity, the functional state of the central nervous system acts as an indicator of the course of the process of adaptation of students to the totality of the conditions of the educational environment [11].

To assess the level of situational and personal anxiety to stress effects, the Spielberger-Khanin test was used.

Statistical analysis of the results was carried out using the Statistica v. 7.0 application software package (StatSoft, USA). Descriptive statistical analysis of the data and correlation analysis were carried out.

## Results

As part of our work, a study was conducted on a voluntary basis by 1st year students. The respondents were students of the Faculty of Primary School Teacher Training and the Faculty of Mathematics, Physics, Computer Science of the South Ural State Humanitarian and Pedagogical University. A total of 97 people participated in the study.

Indicators of sensorimotor reactions and functional state of the central nervous

system among:

- simple visual-motor reaction (PMR);
- complex visual-motor reaction (SPMR);
- tapping test.

The comparison of the PMR indicators at the beginning and end of the academic year did not significantly differ by 3.1%, and slightly more changed by 5.3% in the inter-session period, which was associated with a decrease in the period of sensorimotor reactions and an increase in risk factors such as nervous fatigue and psycho-emotional stress associated with the stress of the first certification tests at the university.

Studies show that reducing the time to achieve a result shows a more perfect functioning of the nervous system, so this indicator is one of the key ones for the dynamic control of the functional state of the central nervous system.

But the studies give two interpretations of the lengthening of the reaction time, which will depend on a decrease in the functional activity of the central nervous system against the background of fatigue, as well as the inclusion of protective inhibition of the nervous system economically consuming energy.

Neuropsychiatric development is associated with the development and state of motor skills, which serves as an indicator of the active activity of the central nervous system against the background of intensive functioning of the motor analyzer. The maximum speed indicators of a person are evaluated through the possibility of performing various actions in a minimum period of time  $t$ , and changes in the pace of movement serve as indicators of the functional state of a person: fatigue, braking, excitation of the NS.

In our studies of first-year students during 1 year of study at the university, they show a slight increase in 2.7% of the teppig test and these indicators can partly serve as the

presence of inert nervous processes, which will be reflected by low indicators of success and thinking, as well as the presence of an average level of concentration and attention switching and the ability to operate with spatial objects. It is known that the same neurophysiological mechanisms that ensure the functional mobility of nervous processes take part in the implementation of these mental functions. Thus, the analyzed psychological functions provide functional mobility of nervous processes based on similar neurophysiological mechanisms.

. Sometimes students, during the session, may experience acute neurotic reactions, which may manifest difficulty in performing an exam or test, a habitual function or form of activity (speech, reading, writing, etc.), and at the subjective level – in a sense of anxious expectation of failure, which acquires greater intensity and is accompanied by complete inhibition of the corresponding forms of activity or its violation.

In psychophysiological approaches to anxiety, two of its components are distinguished: personal anxiety, which is a stable property of personality, and situational (reactive) anxiety, which is more associated with the specifics of a particular situation. High reactive anxiety is associated with a decrease in attention, and sometimes with violations of fine coordination. In contrast, high personal anxiety may correlate with a tendency to neurotic conflict, with the possibility of emotional and neurotic disorders and with a high probability of psychosomatic diseases [6].

To determine the mechanisms of adaptation based on the study of personal and situational anxiety, we used the Spielberger-Khanin test, which allows us to assess the level of anxiety of students and, based on it, to determine the individual sensitivity of students to stressful influences [12].

As a result of the conducted research, it was found that first-year students have a

fairly large number of people with high personal anxiety, which increased by 33.4% before various forms of knowledge control, since such a final form of control of students' knowledge is accompanied by a change in the emotional state of the body and leads to psychoemotional stress. The absence of students with a low degree of anxiety during the session is obvious, since the final certification is accompanied by stress for students.

It is known that stress is a non-specific reaction of the body that occurs under the action of various extreme factors and is characterized by stereotypical changes in the function of the nervous and endocrine systems, since they are, in fact, the main regulatory systems of the body. Stress is an adaptive reaction, as a result of which the body includes protective adaptive mechanisms to the action of more stressful influences, mobilizes its formation, energy and metabolic resources. It is necessary to control that such an adaptive stress reaction is not prolonged and strong, as it can lead to tension of the central nervous system and a decrease in mental activity.

It should be noted that increased anxiety is most often manifested in students with low self-esteem, who underestimate their abilities and strengths and have a weak type of GNI. Their anxiety is characterized by subjectively experienced emotions of tension, anxiety, preoccupation, nervousness and is accompanied by activation of the nervous system, palpitations, increased sweating, etc. In addition, the study noted the correlation of indicators of personal and situational anxiety: students with high indicators of personal anxiety noted that in similar conditions situational anxiety manifests itself to a greater extent.

Studies have shown that the level of students with an average level of anxiety, which contributes to the most successful activity to one degree or another, increased by 10.7%.

Also, according to the results of our

research, we can note a 2-fold increase in people with a low level of personal anxiety. This indicates the lability of the nervous system and the dynamics of psychophysiological states of first-year students, taking into account the direction and magnitude of changes in vegetative indicators.

## Conclusions

Taking into account the different degree of influence of the learning process on the body of students, it is necessary to use in practice a combination of different means of adaptation, taking into account the physiological reactions of the functional systems of the organism that occur when faced with an emotionally stressful situation in the course of educational activity, affecting the quality of educational activity.

The average indicators of neurodynamic processes reflect satisfactory indicators of the functioning of the central nervous system, both in the conditions of simple and complex conditioned reflex activity of the majority of the examined students. At the same time, the most effective speed of cerebral processing of sensory information in the conditions of elementary visual-motor reactions and greater activation and mobility of nervous processes in the central nervous system is observed in students by the end of the academic year, which reflects a more improvement in their mechanisms of adaptive functioning of the central nervous system.

Provision of cognitive activity of pedagogical university students in the conditions of increasing complexity of educational and professional activities in achieving the planned learning outcomes is provided by optimally formed executive cerebral functional systems, which are confirmed by the state of neurodynamic processes characterizing the effectiveness of adaptive mechanisms of cognitive processing of sensory information.

It is necessary to take into account the correspondence of psychological and

neurophysiological capabilities of first-year students to the real educational requirements of modern higher education.

It should also be noted that students with high personal anxiety need to pay special attention, especially when preparing for the final certification. They should use various psychological defense systems, for example, auto-training, a set of breathing exercises.

The obtained results of the surveyed students should be taken into account by teachers in order to develop work programs of disciplines, a conscious choice of active methods and forms of teaching and upbringing, selection of the content of educational material and means of pedagogical influence that affect the further development of students' personality and the disclosure of their potential abilities.

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