

# Blended Learning as a Means of Forming Mathematical Competence of Future Teachers of the new Ukrainian School: Neuropedagogical Aspects

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**Abstract:** *The strategy of education modernization at the present stage, the creation of a new information enlightening space, the use of global network technologies at all levels of education have led to the requirement to increase the level of methodological training of teachers who are ready to use new information technology in their professional activities. The necessity to involve advanced pedagogical technologies that form the student's network culture in the training of specialists in the educational institutions becomes topical. One of such technologies is the technology of blended learning, which combines online learning with face-to-face learning, integrating traditional forms with electronic technologies as an aspect of neuro-pedagogical education. In particular, the concept of blended learning in the context of formation of mathematical competence is clarified and considered as an optimal environment for the development of competence of cooperation and interaction of future teachers in group projects in the conditions of neuropedagogical aspect.*

**Keywords:** *Blended learning, ICT technologies, distance learning, collaboration, cooperation.*

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## Introduction

Today's information technologies get into all spheres of human activity and form a global information space that affects all aspects of society. These processes require modernization of education at all levels. Achievement of this goal is facilitated by the creation of a new educational information space, which gives the opportunity to choose new approaches to introduction of new learning technologies.

A characteristic feature of the current educational environment of both schools and universities is the use of global network technologies that provide students with access to Internet resources from any device; their accessibility, determined by the ability to access them at any time from any geographical location. The process of informatization of education cannot but affect the changes in pedagogical theory and practice of the educational process at all levels of the educational system.

Undoubtedly, the possibilities of information technology in the organization of the educational process are amazing and provide a huge field of activity. In particular, the modernization of education at the present stage, the possibilities of distance learning, the emergence of educational websites, often from reliable information, require from the teacher professional competencies in the use of the global Internet and web technologies in teaching activities. The solution of these complex tasks largely depends on the teacher's readiness to work in the conditions of the growing flow of information. The training of the future teacher to work in the new information space, progressiveness of his views is a necessary condition for the development and implementation of new forms and technologies of teaching based on the active use of information technologies.

The position of organization of the process of formation of mathematical competence of the future teacher on the technology of blended learning is substantiated. The use of professionally oriented method of organizing students' neuro-pedagogical activity aimed at the use of information technology in the mastering of mathematical and methodological content by future teachers is illustrated on the example of class organization.

The use of information technologies in higher education is aimed at improving the quality of specialist training through the use of active and interactive teaching methods; the use of digital technologies in the educational process, which are close to today's youth; the increase of creative and intellectual components of learning activity.

Formation of students' mathematical competence at the present stage of development implies not only updating the content of pedagogical and methodical disciplines in pedagogical areas of the university, but also orientation to the introduction in the educational activity of the university didactic possibilities, which are formed based on neuropedagogy.

Within the framework of the research problem under methodological competence of a future teacher we will understand "an integrative multilevel professionally significant characteristic of his/her personality, expressed in the presence of value attitude to the pedagogical profession, mastered professional knowledge and skills in general.

The purpose of the study – to learn the neuro-pedagogical aspect in the context of blended learning as a means of forming mathematical competence of future teachers of the new Ukrainian school.

### **Features of formation of mathematical competence in the process of obtaining higher education**

The solution of problems of formation of mathematical competence of future teachers is possible through the use of blended learning in the educational space of universities. The formation of the educational process in the context of the implementation of blended learning has certain components (Abulalrub & Stensaker, 2017):

- training does not take place in the classroom;
- priority of individual training;
- advantage of research and creative work;

Trends in education at the present stage - gamification, personalization of learning, blended learning - are gradually being introduced into professional training and university programs (Allman, 2018). One of the current pedagogical technologies, which meets the requirements of the educational process in the universities, is blended learning technology. Blended learning is the combination of online learning with face-to-face learning, integrating traditional forms with electronic technologies.

The use of blended learning technology helps to solve many problems arising in the education system:

- expand accessibility of education at all levels (Atzory, 2015);
- to take into account in the educational process the individual characteristics of students, their needs, the pace of mastering the educational material;
- activate the cognitive activity of students in mastering the educational material;

- to change the style of interaction between teachers and students, to move from the transfer of knowledge by the teacher to interactive interaction with students;

- personalize the educational process, give each student the opportunity to independently determine his/her goals, ways to achieve them taking into account his/her educational needs, interests and abilities (Demchenko et al., 2021).

Organization of the process of formation of mathematical competence of the future teacher takes place with the use of blended learning technology with the following provisions.

1. Integration of the content of mathematical disciplines of subject training to ensure students' understanding and experience of educational knowledge.

2. Creating conditions for the study of mathematical content to deepen and expand school knowledge in order to form students' mathematical skills.

3. Priority of productive learning activity of the future teacher, providing conditions for the development of students' creative abilities in the learning process, individual comprehension of the totality of subject, psychological and pedagogical knowledge in solving specific mathematical problems.

4. Formation of network culture of a student - future teacher as an important component of mathematical teacher training in the present-day universities (Dykan et al., 2021).

5. Student autonomy in the formation and realization of their educational trajectory, providing interactive access of students to common information resources, opportunities for joint productive activities and informal communication, the formation of a personal position of the student.

### **Neuropedagogical approach in the formation of mathematical competence in the implementation of blended learning**

The education system requires from students a high level of cognitive abilities (attention, memory, thinking, analyzing, fast processing and structuring of information). According to numerous studies, more and more children do not cope with social orders, with the curriculum, with the study load and therefore experience difficulties in learning (Evsyukov & Telegina, 2013). Therefore, the introduction of new strategies is necessary for society. Neuropedagogy implies the development of didactic and pedagogical concepts, relying on neurosciences such as neuropsychology, neurophysiology, neurobiology and psychology. With knowledge of the

structure of brain organization, brain functions, functional differences between hemispheres, lateral and modal preferences, and memory types, an individualized approach to learning can be developed (Gardner, 2011).

Every year the statistics of "unsuccessful children" in studies is growing. Common cognitive problems include students' inability to fully assimilate the school curriculum, unfavorable personality traits in behavioral and emotional contexts, and difficulties in interpersonal communication with peers. Of course, all these difficulties begin to arise precisely at school, when everything that was laid down and formed in preschool childhood must grow into a new stage of development - academic education. And if in childhood some process is missed, not formed or laid incompletely, there is a picture of school failure, so it is important for specialists to rely on neuroscience in teaching children (Giddens, 1991).

Neuropedagogy cooperates and considers a complex of neuroscience: neurophysiology, neuropsychology, cognitive neuroscience, differential pedagogy and others,

Thus, neuropsychology of the late 20th century provides a starting point for the development of such a direction as neuropedagogy.

Studying the works of domestic and foreign researchers, it is possible to identify the most effective pedagogical conditions for personalized approach, namely:

- creation of personalized cognitive routes based on neuropsychological diagnostics;
- formation of personal physical culture;
- organization of learning activities;
- relations with the family regarding parent-child relations.

When a child goes to the first grade, his social role changes, his activity changes from playing to learning (Gygli et al., 2019). But what happens when the processes of the formation of learning activity are not analyzed and the maturation of mental functions in general is not considered? When entering school, the child must already master the skills of reading and writing, which are provided by previously formed functions of structural-functional organization of perception, arbitrariness of attention, visual-motor coordination, formation of space and quasi-space, as a result, he begins to "get stuck" in the school program, the first difficulties arise, causing the regression of some insufficiently developed mental functions. Why can't my child read well? Why can't my child count? Why does my child constantly spin around in class and cannot slow down? Of course, here we can argue about the uneven development of the brain organization and specific age differences of students due to the degree of functional maturity

of the right and left hemispheres (Konjuh, 2010). Such a problem has become the basis for the study of learning principles in the conditions of implementation of the new Ukrainian school. Therefore, the problem of school failure is one of the most urgent in the world and leads to the need to introduce school neuropedagogy, in particular, in the new Ukrainian school.

In this pedagogical condition, the work of an educational psychologist with the qualification of a neuropsychologist is important (Kornosenko et al., 2021). Neuropsychological diagnostics allows to identify and prevent difficulties in school learning, to identify weak and strong links in the organization of the brain and, based on the analysis, to develop strategies and methods to improve weaknesses. Neuropsychological diagnosis reveals the goals of psychological and pedagogical education (Kosholap et al., 2021).

Neuropsychological diagnostics allows to determine the profile of lateral asymmetry, predominant modality, neurodynamic indices, spatial factor. Consequently, neuropsychological diagnostics should become the primary pedagogical condition for a personal approach to learning when children are admitted to school. Difficulties arising during school education, without special correction, develop into school failure, which, in turn, leads to the formation of deviance and social disadaptation of the child. Neuropsychological diagnostics allows to reveal developmental delays and prevent the formation of school failure, which is important in the process of implementation of the new Ukrainian school (Kuhn, 1996).

The most typical disorders: decrease in mental efficiency, attention, memory, development of programming and control, difficulties in processing information (visual, auditory, etc.). As a rule, this leads to school failure of a child with normal mental development, the first conflicts and misunderstandings with teachers and classmates appear, adaptation is disturbed (Kryukov & Lutsenko, 2015).

The next pedagogical condition is important to emphasize the formation of physical culture of personality. Formation of motivational and value orientation and socio-spiritual value. And, of course, the main goal here will be not just the acquisition of knowledge, motor skills, and skills, but the education of the student's attitude to physical education, regulating self-knowledge, self-development, self-regulation. Physical activity allows a person to fully exist, triggers productive work of all organs, including the brain, prevents the occurrence of many diseases. According to statistics, every 4th person on the planet has a deficit of physical activity, and if you look at the statistics of children at puberty - 80% of the total number (Lazurenko, 2015).

Active development of information technologies slows down and reduces the motor activity of the population of the planet. New technologies are very interesting and attractive for children and therefore become the main living space of a person. Thus, the preservation of man as a biosocial being becomes jeopardized. Therefore, it is important to introduce into the educational process as much as possible a variety of technologies aimed at the development of motor activity (Leu, 2016).

Physical activity influences the energy resources of the first block of the brain and thus contributes to the increase of neurodynamic parameters. For example, in any correction after neurodiagnosis, much emphasis is placed on sensorimotor correction.

The school program takes into account only bilingual and logical-mathematical routes, and teachers rarely use the other route, which many call non-traditional. Verbal and logical-mathematical thinking is always based on the dominance of the left hemisphere in children, but underestimates the importance of information processing in the right hemisphere: a sense of rhythm, intuition, the creation of images - on this subsequently builds its work. is the basis (Mateiuk et al., 2016). Therefore, future teachers of the new Ukrainian school should take into account the aspect of maturation in the process of learning activities; the use of mechanical memorization, for example, the alphabet: when learning letters, children do not use the emotional connection of holistic perception - do not just study letters, but represent them in 3D, conduct phonemic analysis of the sound, thereby deepening the material, gradually accumulate a large amount of unlearned information, which leads to unsuccessful assimilation of the school program (Nychkalo, 2008).

The concept of "individual lateral profile of a person", where considers the division into three types of brain organization: right hemisphere, left hemisphere and hemisphere. Each hemisphere performs a different function. The left hemispheric type perceives the world according to a discrete model, convergent thinking, auditory perception of information, perceives the image in parts. The right-hemispheric type is characterized by the prevalence of divergent thinking, creativity, a large number of different options for solving problems, in contrast to the left-hemispheric type the image is perceived as a whole. Perception is more visual and kinesthetic (Nychkalo, 2014).

The equal-hemispheric type is characterized by the absence of a clear profile of lateral asymmetry; the two hemispheres together predominate. Of course, it is possible to conditionally divide them into types, because the brain, being active, works as a whole. Because interhemispheric interaction develops in ontogenetic development, which, in turn, is the basis of intelligence. But here it

is important to note the relevance of these types: since children during the control works, because of the large amount of information are subjected to emotional, sensorimotor, neurovegetative stress, often being in a state of exhaustion, the conduction of nerve pathways in the corpus callosum and myelination processes slow down, with the leading hemisphere takes on the load, and the rest is blocked (Padalka & Kalenyuk, 2013).

By determining the type of lateral profile, the teacher can correctly influence the motivation of learning activities. For the right hemispheric type it is important to emphasize prestige in class and social significance; such children have a widely developed need for self-actualization. Left-hemispheric types are directed to the cognitive motive; they are attracted by the process of gaining knowledge, skills and abilities.

Seating at desks in the classroom should take into account the characteristics of the leading modality: visual, kinesthetic and auditory.

Thus, understanding the individual lateral profile of the child, it is possible to determine the leading channel of perception and thus build an individual trajectory of learning in the new Ukrainian school (Parzhnytskyi, 2012).

Thus, neuropedagogy is relevant in modern education, in particular, in the context of the work of the new Ukrainian school, obtaining data on the development of brain organization in ontogenesis. Taking into account the analysis of the peculiarities of child development, it is necessary to highlight the pedagogical conditions for a personalized approach to learning.

For the effectiveness of neuropedagogical education, 4 pedagogical conditions should be formed: individual cognitive routes such as neuropsychological diagnosis, development of physical culture (Prots et al., 2021).

Based on the analysis we can conclude that today in higher professional education the optimal model of training is blended learning, it allows to introduce elements of neuropedagogy in the educational process, making it technological and effective, while preserving the strengths of traditional learning.

### **Blended learning as an important component of formation of mathematical competence in future teachers of the new Ukrainian school**

Blended learning is considered as a combination of elements of face-to-face and e-distance learning (Tamozhska et al., 2023). When designing a blended learning model in mathematics, the approach to supportive and substituted model should be considered. Supportive model of learning does



not require correction in our case, the changed model of learning as characteristic and ideal for blended learning.

It is connected with the special discipline "Mathematics", which is a basic discipline for the first and second year students of engineering and mathematical directions in higher education. At the initial stage it is difficult to master it independently, for this purpose it is necessary to have sufficient preparation in the volume of school course of mathematics, experience of independent work while studying the educational material.

It is clear that in the process of designing a model of blended learning comes the combination of different models, which, in turn, are integrative components that determine the invariant components of any model:

- components of traditional direct personal interaction of participants of the educational process;
- components mediated by electronic educational resources and distance education technologies;
- components of self-education.

Blended learning is a form of educational process in which learning is carried out both by traditional face-to-face and distance learning technologies.

Distance learning is the interaction between teacher and students at a distance, reflecting all the components inherent in the educational process (objectives, content, methods, forms, means of learning). The history of this form of learning includes the following milestones (Vdovych & Palka, 2013).

Thus, recently, the increased interest in the problem of blended learning is explained by the active use of information technologies in the educational process, since distance learning today is realized primarily with the help of specific means of Internet technologies or other means that provide interactivity. In other words, blended learning today is understood as a combination of the traditional form of face-to-face learning and e-learning, characterized by the use of information and electronic technologies, i.e. largely computer-mediated learning. The most important (but not the only) form of e-learning is online learning, which involves the delivery of learning content via the Internet. In turn, the most common in online learning is the use of tools involving online communication, i.e. online learning.

Thus, blended learning (hybrid learning, batch learning) can be defined as an educational technology that combines traditional teacher-led learning and online learning.

## Conclusions

Today there are many scientific publications and practical developments concerning various issues of blended, distance, electronic, Internet and online learning. The conducted research concerns only one, rather narrow aspect of this global problem: the use of distance learning opportunities in the framework of building e-courses corresponding to educational programs of higher education. It is understood that the construction of such e-courses is based on the system capabilities, and their use is carried out in the system of blended learning based on the traditional full-time form of the educational process.

The need to introduce e-courses into the educational process is due to a number of reasons, among which the most significant are the following:

- "informatization" of all aspects of today's society and the need to involve the educational sphere in this process; digital technologies have become a significant source of knowledge, and present-day learning becomes a blended spontaneous way, "dissolving" in the surrounding world;
- objective limitations of the pedagogical potential of a teacher within the framework of classical education and the possibilities of overcoming such limitations in the transition to blended learning;
- objective limitations of the student's cognitive potential within the framework of classical education and the possibility of overcoming such limitations when switching to a mixed form of education;
- polarization of the student contingent and the possibility of overcoming didactic difficulties arising in this connection in the transition to a blended form of education;
- the need to expand the student contingent and the possibility of effectively solving the problem in the transition to blended learning.

The design and realization of blended learning is an actual task that awaits its step-by-step solution. At present, such a task attracts researchers rather in practical aspect: numerous electronic courses in various disciplines, including mathematics, are being developed and introduced into the educational process.

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The Author 4 systematized the features of neuropedagogical approach in the educational process.

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