

Innovative Learning Technologies for Future Elementary School Teachers in the Context of Neuropedagogy

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Abstract: *The article reveals the study of current pedagogy of the essence of the concept of neuropedagogy, opens up the possibility of a new perspective on the pedagogical process, in particular, on the use of innovative technologies of teaching future elementary school teachers in the context of neuropedagogy. The topic is very relevant, as it allows to obtain scientific knowledge about the peculiarities of individual personal development and the impact of the development of psycho-cognitive processes on student learning. The objectives and content of the application of the neuropedagogical approach in the process of learning innovative technologies for future elementary school teachers in the context of neuropedagogy are characterized. The results of our analysis show that neuropedagogy is still not a universally recognized science, but part of the world scientific society has already begun to work in this direction. Scientific works in this field point to the profound potential of neuropedagogy as a future science for creating a favorable environment for learning and application of knowledge. The article shows the role of neuropedagogy in the complex educational system of innovative education and training of students on the basis of achievements of neuroscience; defines the importance of brain organization of cognitive processes of different activities; presents a differentiated approach to learning activities – the most important neuropedagogical factor of successful design of innovative lesson and the effectiveness of innovative educational environment of the university in forming innovative learning technologies of future teachers of elementary school.*

Keywords: *Neuropedagogy, learning, student, psychophysiology, neuroscience, research, educational space.*

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Introduction

Today we understand the need to train teachers who are well versed in the current problems of education and find non-traditional innovative ways to solve them. It is possible to provide a qualitatively new level of training specialists, initiators of innovative processes when creating an innovative educational environment in universities. Within the framework of this article, let us consider the current approaches to determining the structure and content of innovative educational environment of higher education institution and analyze its impact on the formation of prospective teachers' preparedness for creativity.

Neuropedagogy is a new field of pedagogical science in the world. If we recall the results of recent studies of neurobiology and neuropsychology, such examples as different styles of perception and processing of information in the process of student learning, we can safely argue that science can achieve in the future to improve the effectiveness of each student.

Present-day science is based on classical ones – pedagogy, psychology, neurology, cybernetics – and reflects in education a personality-centred approach. The seed of neuropedagogy in the post-Soviet countries has not yet had time to germinate, while the Western countries have already taken a correct and confident course in this direction. An important goal of neuropedagogy is the ability to practically solve creative problems in an optimal way. At the same time understanding individual peculiarities of brain organization of higher mental functions.

Analysis of a number of studies on the modernization of education and ensuring innovative development of society has shown that one of the main problems is the problem of training, education and formation of people capable of ensuring the transition of the Ukrainian economy to an innovative path of development. Today we understand the need to train educators who are well versed in the current problems of education and find non-traditional innovative ways to solve them. Providing a qualitatively new level of training specialists, initiators of innovative processes is possible with the creation of innovative educational environment in the university.

Our analysis of scientific literature and research shows that there are prerequisites in pedagogical science which allowed theoretical understanding of the mentioned problem. Taking into consideration the discoveries of neuroscience is mandatory for assessing the current students' abilities (Dychkivska, 2012; Martynenko, 2012; Zhelanova, 2013). Thanks to them it

became known that self-esteem and self-confidence of a person are related to the neurotransmitter – serotonin. When a person is valued, the transmission of dopamine activates “reward” neurons and feels his power and confidence. They believe that by being aware of such discoveries and considering them in the teaching process, educators are able to diversify their approach to student learning. As Kelly et al. (2002) established, the brain develops in a conducive environment that allows creativity. Under any pressure, compulsion, and threat, brain development is inhibited, so methodological resources should use conditions for independent creative work of the student, because the brain has its own individual characteristics (in terms of volume and speed of perception and processing of information), this or that system of flexibility of thinking processes prevails, etc. Macaro et al. (2012) suggest that teaching materials should be tailored to the psychopedagogical needs, as well as gender, of students in order to stimulate brain potential growth, as opposed to simply providing pre-established information which does not encourage whole-dynamic brain development.

The article aims to show the place of neuropedagogy in the general education system of innovative education and training of students based on the achievements of neuroscience; determine the importance of brain organization of cognitive processes of different types of activities; present a differentiated approach to teaching activities – the most important neuropedagogical factor of successful design of innovative learning; to study the effectiveness of the innovative educational environment of the university in the design of innovative learning technologies for future elementary school teachers.

Neuropedagogy and its Role in a Comprehensive Educational System Aimed at Innovative Education and the Training of Students Using Neuroscience

Neuropedagogy is a comprehensive educational system of education and training, based on the achievements of neuroscience and includes the study of neuropedagogical systems, their properties and processes. It includes the following sciences: neurodidactics, neuropedagogical diagnostics, neuropedagogy of education, neuropedagogical correction and adaptation, neuropedagogical organization (of the educational process).

The human brain is particularly well adapted to mastering new and complex skills due to its inherent plasticity, the ability to adapt while acquiring new experiences. The current potential of “traditional” psychology of training and education is not enough to organize an effective educational

process of students. It is necessary to take into account how their cognitive and emotional-personal spheres develop. And also take into account the peculiarities of cognitive activity, know the strengths and weaknesses of the student's mental development, focus on an individual approach to teach and develop the student. The potentiality of using this methodology is recognized within this research with both children with developmental disorders and typically-developing children (Honcharova, 2008).

The problem of teaching and learning efficiency in the context of the century of information technology, with its high level of daily information load, increased requirements for education, high expectations in the field of professional activity, the desire for continuous development is of particular importance. Student learning is the main indicator of the effective educational process.

All this comes down to the fact that the topic of neuropedagogical approach has not yet been widely spread. However, the prerequisites for development are already outlined. Moreover, the main accent in the analyzed works is made on the necessity of applying neuropedagogics at the secondary level of education: general secondary, elementary vocational and secondary vocational. The prospect of incorporating neuropedagogy into higher education has yet to be contemplated.

The creation of a new field of knowledge called neuropedagogy is being discussed in many countries. A number of scientists tend to believe that this field of knowledge should deal with the remedial education of people with developmental abnormalities, trauma, and brain diseases. In contrast, Perminova (2016) believes that restorative learning is the eventual outcome.

Without denying the very great value of the data on the structure and functions of the brain, let us note that they were conducted on the material of neurosurgery clinics, so at first had not educational, but mainly therapeutic orientation. Consequently, they have found wide recognition and application in medicine and in different spheres of defectology. In Ukraine, on this basis, a broad scientific trend was formed – correctional pedagogy. Many specialists are of the opinion that “private” pedagogy, such as neurographics and neuro-logopedics, etc., should be developed.

It all boils down to making modern private methods of teaching specific academic subjects independent of general pedagogy. Of course, this is wrong, because it transforms the education and training of students in the basics of science into the mastery of individual academic subjects, isolated from the overall goal of developing a well-rounded, harmonious personality.

Neuropedagogy is the highest, current degree of classical pedagogy. It takes into account the achievement of education; selects, refines and develops its most effective methods and techniques, which offers and introduces new, even more effective and covering even more students successfully engaged.

The Relevance of the Brain's Organization of Cognitive Processes to the Instruction of Prospective Elementary School Teachers in the Domain of Neuropedagogy

Neuropedagogy uses such fields of knowledge as cognitive neuroscience, differential psychophysiology, neuropsychology, data on brain organizations of cognitive processes of different types of learning material. The compatibility of variants of individual profile of lateration of a pupil and a teacher, a student and a teacher is taken into account.

Leading foreign specialists in this field have noted that the data of the individual profile of the functional asymmetry of the child's brain at the moment of designing lessons by the teacher are little taken into account.

Feature of a human organism is the functional asymmetry which is shown by different forms of behaviour as at different reactions of behaviour the human consciousness is built on the right or left type.

These cognitive processes are efficient due to the following benefits, as outlined by Arnold-Garza (2014):

- Left-hemispheric, symbolic, or logical thinking enables the manipulation of abstract symbol chains and texts.
- Figurative or intuitive thinking facilitates working with sensory images and the interpretation of these sensory perceptions.

During individual and frontal questioning in the process of organizing knowledge testing, it has been demonstrated that teachers predominantly employ techniques (83%) that have the potential to enhance the left hemisphere of the brain. These methods foster the establishment and advancement of universal cognitive learning activities, which encompass: a) analyzing various components of objects and processes while working with the obtained outcomes; b) identifying distinctions and commonalities between objects and processes, including the characteristics of an object's external and internal structure; c) employing algorithms; d) engaging in classification and category creation, among others.

It is important to note that teachers often employ only 16% of pedagogical methods in their lessons that can stimulate right hemisphere functions in students. Improved comprehension and retention of

information occur when the information and activities align with the visual-spatial memory system. This system operates in accordance with one of the fundamental principles of neuropedagogy, as described by Dumont et al. (2010).

It is so convenient not only to categorize it, but also to find and reproduce it at the right time. The mechanical memorization of that information, which is purely stated by the teacher, is completely different in its performance of the students' activities from figurative memorization, which allows, due to their own searching thought activity, to come to certain conclusions.

Using a Multi-Leveled Strategy to Educational Tasks as the Key Neuro-Pedagogical Component when Crafting an Inventive Lesson Plan

The features with which perception, information processing, intelligence, activity, speech, emotions, memory, and thinking of a person with different profiles of functional brain asymmetry must be taken into account within this vision.

Teaching only the left hemisphere will only result in the left hemisphere gaining knowledge, whereas teaching both hemispheres will lead to the whole brain learning (Phillips, 2010).

It can be argued that when designing a lesson, the teacher should organize the student's activity with the expectation that the left and right hemispheres will function equally. The peculiarities of perception of left-hemispheric and right-hemispheric students should be used with effectiveness, because the style of their work allows the data of neuropedagogy. Research proves the fact that students who are able to think with the right hemisphere work successfully in pairs and groups, and left hemispheric – individually.

Suggestions have been made as to how to set up the educational environment, both in terms of its physical aspects (classroom and furniture), and psychological (student disposition) and psychosocial (teacher-student communication).

The way information is perceived, reacted to, processed and remembered differs, as indicated by advancements in the field of cognitive psychology. Therefore, when structuring the educational process, it is essential, as highlighted by Kelly et al. (2004), to consider:

- Individual lateral profile (functional brain hemisphere asymmetry).

- Gender-specific traits.
- Temperament types.
- Sensory-perceptual organization of experience (considering the primary perception and information processing channel).
- Progression of more complex mental operations.

The 21st century has seen an increase in the interest of researchers in the problem of studying individual and specific ways of processing information about the world around a person, and the term “cognitive style” appears in American psychology. The cognitive style (in pedagogical psychology, the term “learning style” is used) is a leading and habitual way of assimilating and processing information.

In the scientific literature, 10 to 15 cognitive styles are most often named. Their nature is not yet fully understood: they are associated with asymmetry of the brain, with the properties of temperament, with the level of intelligence, with socio-cultural factors. Over the last decade, the study of the accounting of cognitive styles in the learning process and the peculiarities of the perception of left- and right-hemispheres of students have begun to receive attention, but the work is primarily devoted to teaching various subjects in school (especially in elementary school) and teaching foreign languages to students of all ages (from school children to adults).

Using the achievements of neuroscience and neuropedagogy, in particular, a university teacher can change or adjust the methodology and style of his classes, develop individual tasks, increase the efficiency of teaching students and develop their creative abilities. We managed to find several examples of neuropedagogy involvement in the organization of the educational process in higher education institution.

Investigating the cognitive style of “rigidity/flexibility of cognitive control”, Kravchenko (2003) looks into how it affects students’ cognitive abilities. Indeed, education that considers cognitive styles is feasible under conditions of flexible internal differentiation, which establishes favourable circumstances for individualizing the educational process through a diverse and adaptable learning environment, as well as through various forms of interaction among students with distinct cognitive tendencies (Kravchenko, 2003).

By internal differentiation we mean the organization of learning, in which individual abilities will be carried out within the framework of their training of students in groups. It has been analytically proven that while taking into account students’ cognitive styles is indeed very important, the

development and implementation of such methodological systems in most universities has not been carried out.

Thus, neuropedagogy helps to organize learning by taking into account psychophysiological and neuropsychological patterns of development. Research in neuropedagogy is relatively recent, but its emergence is due to the significance of neuroscience advances. There is a growing appreciation among teachers of both academic and practical fields in schools and universities for these achievements.

The results of our analysis show that neuropedagogy is still not a universally recognized science, but some part of the world scientific society has already started to work in this direction.

Moreover, it is possible to state the unity of views of all researchers on the positive impact of neuropedagogical influence on students. Hence, it follows that it is only a matter of time to define the subject and form the methodology of neuropedagogy, since scientific works in this field point to the deep potential of neuropedagogy as a future science which would take into account neurophysiological, neuropsychological and individual personal features of all participants of the teaching process, creating favorable environment for learning and application of knowledge.

Assessing the University's Innovative Educational Environment in Fostering Innovative Learning Technologies for Future Elementary School Teachers

This article evaluates the present strategies for constructing and organising a creative learning environment in a higher education institution, and investigates its effects on the development of future teachers' preparedness for innovative work.

Today the learning model and modern conditions defining new contexts of teacher's activity are changing. Multilevel training of specialists requires creation of new educational environment in universities, which maximally promotes formation of general scientific, professional competences and innovative competences.

Innovative competencies entail the cultivation of a suitable mindset toward innovation and coping with uncertainty. They encompass the capacity to respond swiftly in such circumstances and to make informed decisions proactively. The primary innovative competencies encompass a readiness for continuous education and improvement, a commitment to self-directed learning and retraining, professional adaptability, a thirst for novelty, critical thinking skills, both independent and collaborative work abilities, and a willingness to thrive in a competitive environment.

The system of education at all stages, starting from preschool, in terms of content, methods and technologies of education is facing the task of orientation on formation and development of skills and competencies necessary for innovative activity.

As evidenced by university practice, the creation (transformation) of educational environment of higher education institution is a complex, multifaceted, large-scale problem. Its solution requires comprehensive resource, first of all, scientific support.

The educational environment is a set of organizational and didactic conditions and factors, as well as interpersonal relations, established in the pedagogical process, which influence the formation of a personality with the given qualities.

Kotenko (2014) suggests that the deliberate establishment of an educational environment in the university accomplishes several key objectives:

- It facilitates the inclusion of students in various cultural and social relationships of different types and levels.
- It nurtures the development of their motivational and semantic sphere, enhancing their intrinsic drive and understanding.
- It constructs the educational process by focusing on the cultivation of productive experiences.
- It promotes the individualization of the learning process by creating and implementing individualized educational programmes for each student.

Husak (2014) describes the defining mark of an innovative educational environment as the combination of the primary components of personal growth – the atmosphere of life activity, instruction, self-learning and self-development, all working together to help the student utilize their creative capabilities. This environment is a complex mechanism of enacting the core ideas of progressive pedagogy, and the only educational space of an educational facility which allows connecting the efforts of all related parties for delivering superior instruction to prospective specialists.

According to Honcharova (2008), an innovative environment encourages innovative potential, which is pivotal in generating new ideas, in making new products and technologies, in conducting fundamental and applied research, which are relevant to different branches of knowledge and propel innovative activity.

Consequently, an innovative educational environment is characterized as a result of the subjective interactions of all participants in

the educational process. It is distinguished by its foundation on the following principles:

- Innovative educational content, manifest in unique educational programmes and individual learning paths for students.
- Innovative educational technologies grounded in transdisciplinary methodologies, interactive teaching approaches, and mentoring.
- Innovative teaching techniques aligned with the contemporary methods for working with young individuals.
- Novel models of educational environment administration by establishing situational and predictive centres within universities.
- A secure educational setting within higher education institutions, with a focus on continuous hazard monitoring and regulation, aiming to uphold the quality of education in these institutions (Kravchenko, 2003).

Innovative educational environment of higher education institution is a set of content, forms, methods and means of learning, based on the transfer of achievements of today's science and technology in the educational process of higher education institution and aimed at the formation of innovative personality of students, capable of making creative decisions in the professional field. The success of the formation of students' readiness to innovative activity depends on the creation of conditions for the development of creative potential in the educational process.

Pedagogical Conditions Necessary for Creating an Innovative Educational Atmosphere and Its Contribution to Forming Innovative Teaching Techniques for Future Elementary School Teachers

We determine the following pedagogical conditions of formation of future teacher's readiness for innovative activity:

- creation of innovative and creative environment in the university;
- formation of value attitude to innovative activity and its results;
- organization of creative interaction in the system "teacher-student";
- human-oriented orientation of technology to create a culture of innovation;
- mastery of innovative pedagogical technologies by future teachers.

It should be noted that the innovative activity of a teacher in modern education is the most important component of the creative process. It is a

purposeful pedagogical activity aimed at implementing new pedagogical practices that contribute to improving the quality of education. In this context, the teacher's readiness for innovative activity is important. conditions for their professional development.

Nenko et al. (2022) state that a teacher's willingness to take part in innovative activity is dependent on the development of their motivation, knowledge, abilities, skills, both professionally and personally relevant attributes, and the necessary growth and execution of pedagogical improvements in order to address the educational process's issues, as well as to discover and apply successful methods to resolve them.

Motives, degree of irritation, orientation reflect the personal readiness of the teacher for innovative activity. Theoretical readiness consists in mastering the basics of pedagogical innovation and implies the possession of theoretical activity, manifested in an innovative style of thinking. The leading components of theoretical readiness are constructive and diagnostic activity. Both types of activity require a teacher to have developed analytical, predictive, projective and reflexive skills.

Currently, there are several approaches to the formation of teachers' readiness for innovation in terms of content and design, the most well-known are the personal and functional approaches.

The personal approach assumes readiness as an expression of the individual qualities of the personality and their integrity, determined by the effectiveness of high-performance activities. The functional approach assumes consideration of readiness as a mental state of the individual.

As noted by Karasievych et al. (2021), teacher readiness for innovative activities can be broken down into several key components:

- **Motivational Component:** This element encompasses the teacher's motivation for self-education and their desire for professional advancement.
- **Cognitive Component:** This aspect involves the teacher's knowledge and understanding of pedagogical innovations.
- **Personal Component:** This component relates to the teacher's awareness of their own level of innovative competence.
- **Active Component:** This segment entails the skills and abilities necessary for engaging in innovative pedagogical activities.

Each of these components plays a crucial role in a teacher's capacity to effectively engage in innovative educational practices (Karasievych et al., 2021).

The teacher's readiness for innovative activity is determined by the following indicators: a) awareness of the need to implement pedagogical innovations in their own pedagogical practice; b) knowledge of the latest pedagogical technologies, knowledge of innovative methods of work; c) orientation towards development of own creative tasks, methods, readiness for experimentation; d) willingness to overcome difficulties related to the content and organization of innovative activities; e) possession of practical skills of mastering pedagogical innovations and developing new innovations.

We believe that in order to develop future teachers' readiness for pedagogical innovation, it is necessary to create a unified university environment that will work for one comprehensive result: training innovation-minded teachers. It is necessary to bring to the forefront not narrowly professional competencies, but general innovative competencies, such as ability and readiness for continuous education, continuous improvement, self-learning and retraining, professional mobility, desire for new things, proficiency in critical reasoning, creativity and enterprising attitude, proficiency to work independently and as part of a team, enthusiasm to work in a competitive setting.

Hence, we see the task:

- to form an innovative culture in future teachers;
- to develop innovative competencies;
- to nurture innovative thinking;
- to promote innovative activity;
- to cultivate the need for self-education.

Karasievykh et al. (2021) firmly believe that by providing the necessary environment for innovation projects and practical innovation activities at the university, graduates who are capable of innovating, who can confront the difficulties of the present era, and who are prepared to revolutionize the environment and themselves can be formed.

This requires the constant improvement of methods, tools, teaching and learning techniques, and educational technology. In the teaching of disciplines should introduce their own scientific and methodological developments. In the curricula clearly allocate practice-oriented components, active and interactive teaching methods, use innovative methods of education and technology that improve the effectiveness of learning and self-learning.

The formation of the future teacher's readiness for innovative activities should be based on the integration, fundamentalization of knowledge, as well as on the personal-activity, competence and contextual approach of training specialists in higher education institution.

Conclusion

The importance of the article is to bring the role of neuropedagogy in a comprehensive educational system of innovative education and training of students based on the achievements of neuroscience, because the current potential of the traditional psychology of training and education is not enough to organize an effective educational process of students, and therefore we need to consider how their cognitive and emotional and personal sphere develops, peculiarities of cognitive activity, know the strong and weak sides of the student's mental development, focus on an individual approach for learning and development of the student. In this perspective, the problem of learning and teaching efficiency in the age of information technology, with its high level of daily information load, increased requirements for education, high expectations in the field of professional activity, the desire for constant development becomes important.

The article defines the importance of brain organization of the cognitive processes of different activities and concludes that when designing a lesson, the teacher must organize the activity of the student, taking into account the functioning of the left and right hemispheres equally. It has been proved that the peculiarities of perception of left-hemispheric and right-hemispheric students, the style of their work allow more effective use of neuropedagogy data. Studies have indicated that students with a right-hemispheric orientation excel when working in pairs or groups, while those with a left-hemispheric orientation prefer to work on their own.

Also presented a differentiated approach to pedagogical action – the most important neuropedagogical factor for the successful design of innovative learning and the effectiveness of innovative educational environment of the university in the formation of innovative learning technologies of future elementary school teachers and subsequent pedagogical conditions for the formation of future teachers' readiness for innovative activity are defined: the creation of innovative and creative environment of higher education; formation of value attitude to innovative activity and its results; organization of creative interaction in the "teacher-student" system; personality-oriented technology development of the culture of innovation; mastery of innovative pedagogical technologies by future educators.

Therefore, innovation activities of a teacher in today's education is the main purposeful pedagogical activity aimed at the introduction of new pedagogical practices that improve the quality of education.

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Author 1 expanded the concept of the role of neuropedagogy in a comprehensive educational system of innovative education and training of students based on the achievements of neuroscience. Authors 2 and 3 defined the importance of brain organization of the processes of cognition of different types of activity. Author 4 presented a differentiated approach to learning activities – the most important neuro-pedagogical factor in the successful design of an innovative lesson. Authors 5 and 6 proved the effectiveness of innovative educational environment of universities in the formation of innovative learning technologies of future elementary school teachers, selected scientific research of Ukrainian and foreign scientists and streamlined the list of literature.

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