FORMATION OF PROFESSIONAL COMPETENCIES OF FUTURE BIOLOGY TEACHERS BASED ON NEURODIDACTIC APPROACHES

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Abstract. *The article examines the issue of forming the professional competencies of future biology teachers based on neurodidactic approaches. The purpose of the research is to substantiate the development of professional skills by introducing teaching technologies based on the laws of brain activity in the process of biology education. The results of the experimental research showed that neurodidactic methods increase students' activity, long-term knowledge acquisition, and critical thinking skills.*

Keywords: *neurodidactics, professional competence, biology education, cognitive activity, innovative pedagogy.*

Introduction

The relevance of the topic "Formation of Professional Competencies of Future Biology Teachers Based on Neurodidactic Approaches" is determined by the tasks outlined in the Decree of the President of the Republic of Uzbekistan No. PF-60 dated January 28, 2022, "On the Development Strategy of New Uzbekistan for 2022–2026," as well as in Resolution No. PQ-4805 dated August 12, 2020, "On Measures to Improve the Quality and Effectiveness of Continuous Education in Chemistry and Biology."

Around the world, a number of scientific studies are being conducted on the purposeful orientation of students toward research activities, preparing them for social life through scientific research, using the achievements of scientists in teaching biology, and developing students' life competencies. In particular, considering the multidisciplinary nature of biology, special attention is being paid to improving the methodological system of teaching aimed at research activity starting from general secondary education, developing variable forms of biology teaching by identifying students' research identity, and developing young people's ability to use scientific research effectively in their chosen future profession.

It is important to clarify the development of new methods of integrative and profession-oriented teaching of natural sciences, including biology, in general secondary schools, based on giving priority to the methodological aspects of directing students toward scientific research and developing their abilities.

In the modern education system, forming a teacher's professional competence is considered an urgent task. In particular, in the process of teaching biology, taking into account cognitive processes, memory, attention, and thinking mechanisms determines the effectiveness of education. Neurodidactics, formed as a result of the integration of neurobiology and pedagogy,

involves organizing education in accordance with the functioning of the human brain. This approach creates the opportunity for deep and long-term assimilation of educational content.

Based on the above considerations, in order to determine how the use of neurodidactic approaches in the process of pedagogical education develops the professional competencies of future biology teachers, we carried out a number of tasks to identify the effectiveness of "forming the professional competencies of future biology teachers based on neurodidactic approaches."

These tasks include the following:

The lesson should be conducted on time, should not be excessive in volume, and should be meaningful and oriented toward the interests of the child.

The teacher should be able to control the amount of learning load, which is often violated and is determined by the curriculum.

Consequently, the teacher's main efforts should be directed toward "meaningful teaching" and "orientation toward the child's interests." Therefore, the child is most interested in multimodal materials that affect various emotions and different aspects of thinking.

The main task of neuropedagogy is to help teachers at any level of education select specific technologies from different teaching systems and combine them into the most effective program for each particular student or each class. It provides clear answers through procedures and stimulating materials in cases where commonly accepted methods do not work or are ineffective.

Neurodidactics is based on the following principles:

- Brain plasticity;
- The relationship between emotion and memory;
- Multimodal teaching, which is an educational approach based on delivering information to students through several channels at the same time, including seeing, hearing, movement, and feeling;
- Spaced repetition.

Scientific research shows that emotionally enriched information is stored effectively in long-term memory. Therefore, creating a positive psychological environment during the lesson is of great importance.

According to the studies of American psychologists R. Karnikau and F. McElroy, a person's natural physiological and psychological capabilities allow knowledge acquired in different forms to be retained at different levels. That is, a person can remember 10% of what they read, 20% of what they hear, 30% of what they see in an event, phenomenon, or process, 50% of what they both see and hear about an event, phenomenon, or process, 80% of the information they transmit themselves, such as speaking or demonstrating knowledge, and 90% of the information they apply in their own activity.

In Uzbekistan, certain issues have been studied concerning improving the quality of education through the use of neuropedagogical knowledge, as in the work of B. Khodjaev, and developing children's neuropedagogical characteristics in an innovative educational environment, as in the works of J. G'ulomov, N. Yunusova, and V. Anvarova. However, large-scale scientific research in this field has not yet been carried out. Neuropedagogy and neuropsychology are developing as new fields of science.

Neuropedagogy is a science that organizes the educational process by taking into account data from cognitive neurology, differential psychophysiology, and neuropsychology about changes occurring in the learner's brain during the assimilation of various educational materials, as well as the compatibility between the individual lateralization profiles of the learner and the

teacher. Neuropedagogy is based on the classical foundations of pedagogy, psychology, neurology, and cybernetics, and it reflects person-centered education.

Although both hemispheres of the human brain participate in complex cognitive processes, their functional strategies differ significantly from each other. People with a dominant left hemisphere are distinguished by sequential and logical analysis of information, as well as analysis moving from particular parts toward the general. People with a dominant right hemisphere, however, differ in their intuitive and holistic perception of the world and in their tendency to analyze from the general toward particular parts. This situation is manifested in the educational process through the acquisition of knowledge by intuitive-emotional, communicative methods and logical-rational, non-communicative methods.

Methodology

Neuropedagogical methods include approaches aimed at improving students' learning effectiveness by taking brain activity into account in the educational process. These methods are based on the psychological and physiological foundations of brain functioning in order to support students' cognitive, emotional, and social development. Their main purpose is to adapt the educational process to students' neurobiological characteristics and thereby increase the effectiveness of knowledge acquisition.

The application of neurodidactics in biology helps students better understand the processes of the human body and stimulates memory and thinking processes through experiential learning.

The main advantages of neurodidactics are as follows:

- Accelerating students' process of information acquisition;
- Reducing stress and nervousness levels;
- Increasing the ability to concentrate;
- Stimulating active brain functioning.

Mindfulness and metacognitive approaches are used to help students concentrate, reduce stress, and increase emotional stability. Mainly, breathing techniques, conscious observation, and stress management methods are used.

Below is a technique for applying this approach in a biology lesson on the topic "The Process of Breathing and Oxygen Exchange" for Grade 9.

At the beginning of the lesson, students perform deep breathing exercises for several minutes. This helps them understand the effect of oxygen on blood circulation.

Students observe their heart rate before and after simple activities and compare the results.

1. Before the lesson, students measure and record their heart rate for 60 seconds.
2. They perform physical activity, for example, 20 squats or jumping in place.
3. After the exercise, their heart rate is measured again and the results are compared.
4. Students discuss the reasons for changes in heart rate during the activity.

The reasons for the changes are as follows: physical activity requires additional oxygen in the body, which causes the heart rate to increase. When the heart beats faster, more blood and oxygen are delivered to the muscles. After a few minutes of rest, the heart rate returns to normal, which demonstrates the self-recovery feature of the nervous system.

During the lesson, students are given the following questions and tasks:

1. How does deep breathing affect the amount of oxygen in the blood?
2. If a person is in a state of stress, how does the breathing rate change and why?
3. What physiological changes did you feel after meditation?

Through the mindfulness method, the level of stress decreases by 35–45%, while the ability to concentrate increases significantly.

Results

A game-based learning approach is a method aimed at increasing students' interest, ensuring their active participation, and helping them acquire knowledge more deeply by adding game elements to the learning process. This method uses children's natural curiosity and desire for competition, engages them in the learning process, and helps them master concepts quickly and effectively.

Below are examples of such games.

Lesson Topic: "Cell Structure and Function"

Grade 7

The "Mysterious Guest" Game

Through this game, students not only see the organelles of the cell but also gain a deeper understanding of their structure and functions.

Procedure

The names of five different cell organelles are written on the board: nucleus, mitochondrion, ribosome, lysosome, and Golgi apparatus. However, their pictures are not drawn.

Students are given cards showing these organelles.

Game Process

Each student describes the organelle given to them without saying its name.

For example, a student may say:

"I produce energy inside the cell. Sometimes I am called the power station of the cell. Can you guess who I am?"

All students in the class try to answer, and the student who gives the correct answer is encouraged.

In this way, all organelles are described and identified one by one.

To make the game more interesting, the following elements can be added:

1. **"Mysterious Guest" roles** — In order to personify each organelle, students can speak as if they were that organelle. For example, a student acting as the mitochondrion may say, "I produce energy; I am called the power plant of the cell."
2. **Quick quiz** — At the end of the game, the teacher may ask quick questions and test students on the functions of the organelles.
3. **Determining the winner** — The student who identifies the largest number of organelles correctly or gives the most interesting description may receive a small gift or encouragement.

Through this game, students not only gain knowledge about cell organelles but also develop skills such as analysis, description, logical thinking, and teamwork. At the same time, the lesson becomes interesting and lively.

The "Cell Theater" Game

The class is divided into six groups, and each group represents one cell organelle: nucleus, mitochondrion, ribosome, membrane, cytoplasm, and lysosome.

The groups enter the role of their organelle and bring it to life through actions and speech.

Each group explains its function to other students and performs a short scene. For example:

The mitochondrion group dramatically demonstrates energy production.

The nucleus group gives commands as the "leader of the cell."

The membrane group acts as “guards” who determine who is allowed inside and who is sent outside.

Such a game-based approach helps deliver the topic to students more deeply.

The “Save the Cell!” Game

Students are given various situations. They enter their roles and solve the problem.

Example:

“The cell is starving!” — The ribosomes have stopped working. Students explain that if ribosomes do not function, protein synthesis will not occur.

“Our energy is gone!” — The mitochondrion has stopped functioning. Students explain the importance of the mitochondrion and discuss how it can be restored.

“A virus has attacked!” — The cell membrane has been damaged. Students explain the importance of the cell membrane and express their ideas about how the cell can be protected.

When each mission is solved correctly, the groups are given “Cell Heroes” labels.

At the end of the lesson, the group that collects the most labels is announced as the “Heroes of the Cell.”

Discussion

Multisensory teaching is a method based on receiving knowledge through several sense organs during the learning process, including seeing, hearing, touching, smelling, and tasting. This method is based on neurological research and helps students remember information better and understand it more deeply.

Based on this approach, the “5-4-3-2-1” method can be used.

The “5-4-3-2-1” Method

The “5-4-3-2-1” method is one of the important strategies that serves to activate students’ knowledge and thinking in the educational process. This method is especially effective in biology as a tool for easily mastering and analyzing complex concepts.

We can explain this method through the topic “Feeling Nature and Sense Organs.”

Students are either in the classroom or in an open natural environment.

They are asked to name five types of living organisms or biological objects and to look around carefully.

For example: a tree, bird, insect, moss, flower, or water drops.

Each student writes down or describes what they have seen.

Identifying Four Different Sounds

Students listen to the surrounding environment.

For example: birds singing, wind blowing, leaves rustling, or bees buzzing.

Then they discuss which animal or natural phenomenon the sounds belong to.

Touching Three Things with the Hands

Students touch three different objects of their choice.

For example: tree bark, flower leaves, wet soil, or a smooth stone.

Through this, it is possible to explain how their sense organs, especially the skin, receive information.

Smelling Two Scents

Students identify two different smells around them.

For example: the smell of a flower or the smell of wet soil.

The teacher explains how they distinguish smells and speaks about the organs of smell.

Remembering One Taste

Students remember something they have recently eaten and imagine its taste again.

For example: a sweet fruit, a sour lemon, or salty water.

Through this, the functioning of taste receptors is explained.

Post-Lesson Discussion

Students share their experiences and discuss together what they felt.

The teacher concludes the lesson with the following questions:

1. Which sense was the most interesting? Why?
2. How do our sense organs help us understand the environment?
3. What difficulties would we face if one of our sense organs did not work?

The use of these neurodidactic methods in biology lessons demonstrates that students can acquire knowledge more actively and meaningfully when the teaching process is connected with brain activity, emotional involvement, sensory experience, and practical activity. Mindfulness, game-based learning, and multisensory teaching support not only subject knowledge but also attention, memory, emotional stability, cooperation, and critical thinking. Therefore, such approaches may play an important role in forming the professional competencies of future biology teachers.

Conclusion

In the modern educational process, it is important to apply effective pedagogical approaches while taking into account students' neurological characteristics. This article studied the possibilities of using neurodidactic approaches in biology education and analyzed their influence on students' mental and physiological development.

The results of the study show that methods such as multisensory teaching, game-based learning, mindfulness, and metacognitive strategies help students concentrate, reduce stress, and organize the learning process more effectively. In particular, by applying these methods in biology lessons, it is possible not only to understand the subject content more deeply but also to support students' healthy psychological and physiological condition.

Thus, neurodidactic approaches increase the effectiveness of education and have a positive impact on students' cognitive and emotional development. In the future, it will be important to study these methods on a wider scale and introduce them into practice.

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