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METHODOLOGY FOR TEACHING BIOLOGY LESSONS USING ARTIFICIAL INTELLIGENCE AND VIRTUAL REALITY TECHNOLOGIES

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Summary. This article discusses innovative approaches to teaching the functioning of the human brain in biology lessons through the use of artificial intelligence (AI), virtual reality (VR), and interactive teaching methods. Since the human brain is one of the most complex and mysterious biological systems, traditional teaching methods are often insufficient for helping students fully understand its physiological processes. Therefore, the article analyzes the use of 3D models, neural animations, virtual laboratories, and AI-based platforms to explain complex biological mechanisms such as neuron activity, nerve impulse transmission, reflex actions, and memory formation. Special attention is given to innovative methods such as "Neuron Detective," "Brainstorming," and "Video Puzzle," as well as their pedagogical effectiveness in biology education. The findings show that modern digital technologies significantly improve students' analytical thinking, visual memory, scientific observation, and cognitive engagement.

Key words: human brain, artificial intelligence, virtual reality, neurons, biology education, interactive learning, innovative methods, VR, AI, neurotechnology.

In today's age of technology, humanity is creating artificial intelligence, exploring outer space, and processing billions of pieces of information within seconds. Nevertheless, one of the most complex biological systems that continues to amaze scientists is the human brain. This unique structure, consisting of approximately 100 billion neurons, is the central organ that controls human thinking, memory, emotions, speech, and movement. Every thought, every feeling, and every decision arises as a result of the functioning of this complex biological mechanism.

The famous physicist Albert Einstein once said about the human brain:

"I am always amazed by the human brain. It is one of the most mysterious objects in the universe."

Indeed, teaching the functioning of the human brain in biology lessons requires a high level of pedagogical mastery from the teacher. This is because the movement of impulses between neurons, the activity of synapses, and the formation of reflexes cannot be observed with the naked eye. As a result, students often perceive this topic as complex and abstract.

Static images in traditional textbooks and simple theoretical explanations cannot fully represent the dynamic processes occurring in the brain. Therefore, in modern biology education, the use of artificial intelligence, virtual reality, neuro-animations, and 3D modeling technologies is becoming an important pedagogical necessity. With the help of these technologies, students not only hear or read about biological processes, but also observe them visually, analyze them, and experience them in a practical way.

The main goal of modern pedagogy is to transform the student from a passive listener into an active researcher and an individual capable of biological thinking. In this regard, innovative technologies are opening a new stage in the teaching of biology.

In biology, the topic of the human brain is considered one of the most complex sections. This is because physiological processes such as the movement of nerve impulses, synaptic transmission, reflex arcs, and the activity of neurotransmitters cannot be observed directly. As a result, students may experience difficulties in understanding the topic.

Virtual reality technology transforms biology lessons from simple theoretical instruction into an interactive scientific experience. Through VR technology, students have the opportunity to observe the cerebral hemispheres, cerebellum, hypothalamus, medulla oblongata, and the functioning of neural networks in a three-dimensional format.

For example, in a VR environment, a student can observe “from the inside” how a nerve impulse moves along a neuron. As a result, abstract biological concepts are formed in the student’s mind as clear and visual images.

Artificial intelligence technologies, in turn, strengthen the individualized approach in biology education. AI platforms analyze students’ level of knowledge, response speed, and errors, and generate tasks appropriate to their individual needs. This helps to organize each student’s learning process more effectively.

The renowned scientist Stephen Hawking once said about artificial intelligence:

"Artificial intelligence could be the greatest achievement in human history."

In teaching the functioning of the human brain, modern pedagogy is not limited to providing theoretical information alone. This is because neuronal activity, the movement of nerve impulses, and the formation of reflexes are complex biological mechanisms. Therefore, in biology lessons, it is especially important to use interactive methods that actively engage students in the topic and develop their scientific thinking and observation skills.

Methods integrated with virtual reality and artificial intelligence technologies are particularly effective in further increasing the efficiency of biology education. In teaching this topic, the methods known as **"Neuron Detective," "Brainstorming,"** and **"Video Riddle"** are applied in close interconnection with one another.

These methods help students understand biological processes step by step, draw independent conclusions, and visualize complex topics more clearly. During the lesson, the **"Brainstorming" method** is first used to increase students' interest in the topic and to develop their scientific thinking in relation to problem-based situations.

The "Brainstorming" method plays an important role in developing students' creative thinking and their ability to make scientific hypotheses in biology lessons. During the application of this method, the teacher asks students unusual and problem-based questions related to the functioning of the human brain.

The renowned neurophysiologist Charles Sherrington once stated:

"The brain is an ocean of millions of flashing signals."

This idea clearly demonstrates the complexity of biological processes. Therefore, during the lesson, students may be asked the following questions:

Why is the human brain more complex than artificial intelligence?

Why does stress weaken memory?

What would happen if neurons did not transmit signals?

Can artificial intelligence come close to human consciousness?

Students express their opinions freely, draw biologically grounded conclusions, and approach problem-based situations creatively. As a result, a biology lesson is transformed from a simple lecture into a scientific discussion.

After this, in order to develop students' ability to analyze biological processes more deeply, the lesson proceeds to the "Neuron Detective" method.

The "Video Riddle" method is one of the innovative methods that turns

biology lessons into an engaging scientific adventure. During this method, students are shown short videos related to the functioning of the nervous system.

The videos illustrate complex biological processes such as the movement of nerve impulses, reflex arcs, synaptic activity, memory formation, and the effects of stress on the brain. The video is paused at a certain point, and students are asked questions that require biological analysis.

For example:

What will happen in the next stage of the process?

Through which neuron is the impulse moving?

Why has the signal slowed down?

In which part of the brain is this process taking place?

The famous neurologist Sigmund Freud once said:

"The human brain is a mysterious world that has not yet been fully explored."

Indeed, through this method, students feel like biologists or neuro-detectives. As a result, their observation skills, rapid analytical thinking, and ability to draw scientific conclusions are developed.

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Innovative Methods and Technologies	Application Process	Pedagogical Effectiveness
Virtual Reality (VR) Technology	Demonstrating brain anatomy and neuronal activity in 3D format	Develops students' visual thinking and helps them clearly imagine complex biological processes.
Artificial Intelligence (AI) Platforms	Analyzing students' level of knowledge and their responses	Provides an individualized approach, strengthens knowledge, and increases learning efficiency.
Brainstorming Method	Exchanging ideas freely on the basis of problem-based questions	Develops creative thinking, scientific reasoning, and independent thinking skills.
"Neuron Detective" Method	Analyzing the movement of nerve impulses in a virtual environment	Forms logical thinking, biological analysis skills, and the ability to solve problem-based situations.

"Video Riddle" Method	Observing and analyzing videos related to biological processes	Develops observation skills, the ability to draw quick conclusions, and biological thinking.
3D Modeling	Modeling brain regions and the structure of neurons	Strengthens visual memory and helps students master the topic more easily.
Interactive Animations	Dynamically illustrating reflex arcs and synaptic activity	Simplifies abstract biological concepts and increases students' interest in the lesson.

The results presented in the table show that the use of artificial intelligence, virtual reality, and interactive methods enhances the effectiveness of biology education and contributes to the development of students' biological thinking, independent reasoning, and scientific analysis skills.

In conclusion, the use of artificial intelligence, virtual reality, and innovative interactive methods in teaching the functioning of the human brain in biology lessons raises the quality of education to a new level. Through these technologies, students not only observe biological processes, but also experience them, analyze them, and draw scientific conclusions.

In particular, methods such as "Neuron Detective," "Brainstorming," and "Video Riddle" transform biology from a simple theoretical lesson into a scientific adventure. As a result, students perceive biology not merely as an academic subject, but as a scientific key to unlocking the mysteries of the human mind..

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