АКТУАЛЬНІ ПИТАННЯ ПРОБЛЕМ ЕКОЛОГІЧНОЇ ОСВІТИ, ВИХОВАННЯ ТА МЕТОДИКИ НАВЧАННЯ ПРИРОДНИЧИХ ДИСЦИПЛІН

CONCEPT OF DEVELOPMENT OF NATURAL EDUCATION IN THE CONDITIONS OF NEURAL NETWORK ITERATIONS

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Abstract. Modern education is undergoing transformation due to digitalization and integration of new technologies, one of the key factors is the development of artificial intelligence (AI) and neural networks, which are actively introduced into the educational process. This is especially true of natural sciences, where large volumes of data are analyzed, modeling and forecasting play a critical role.

Information technologies, in particular artificial intelligence (AI) and neural networks, play a key role in the transformation of natural education. The article considers the concept of iterative development of neural networks and their impact on the methods of teaching the discipline of the natural cycle. Also, the possibilities of applying AI in biology, physics, chemistry, geography, ecology, agricultural sciences and medicine are analyzed.

The impact of AI on natural education is significant and the result is transformative. Due to adaptability, the possibilities of automation and individualization of learning, AI opens up new opportunities for improving the quality of education. However, at the same time, important ethical issues related to the use of AI are involved, in particular, in the context of privacy and preserving the role of the teacher. Further development of AI in education requires a thoughtful approach to maintain a balance between technological achievements and human values, which are the basis of the educational process.

Key words: education, natural sciences, iteration, neural networks, artificial intelligence.

Introduction. Important in the study of artificial intelligence and its impact on science are successful foreign scientists such as Geoffrey Hinton, one of the pioneers in the field of deep learning and neural networks, who developed the error backpropagation algorithm used in training neural networks; Yann LeCun, one of the creators of convolutional neural networks, who is actively working in scientific research, including the analysis of biological images and the prediction of climate change; Yoshua Bengio, a leading researcher in scientific intelligence, who is engaged in the development of deep learning methods used in the natural sciences; Demis Hassabis, co-founder of DeepMind, developer of AlphaFold, a revolutionary model that provides the structure of proteins, contributing to the development of biology and medicine; Max Tegmark, a physicist and AI researcher who analyzes the impact of artificial intelligence on science and education.

In general, neural networks significantly expand the capabilities of natural education, making it more interactive, effective and innovative. The introduction of modern technologies in the training of a new generation of scientists capable of working in the conditions of digital transformation and global challenges of the 21st century.

Natural education, as is known, encompasses disciplines that study natural phenomena, in particular physics, chemistry, biology, geography, ecology and astronomy, the main task

of this field is to form ideas about the regularity of the environment, the development of analytical thinking and a scientific worldview.

Purpose: to substantiate the concept of the development of natural education in the conditions of iterations of neural networks, to explore the possibilities of integrating modern artificial intelligence (AI) programs into the educational process and to apply their influence on the formation of natural competencies of pupils and students.

Materials and methods: The methodological basis of the work is the generalization and analysis of known scientific results regarding the influence of Shi on the formation of modern natural science education using a systemic approach. To form a scientific problem, determine the goal and set the objectives of the study, an analytical method and comparative analysis were used. It should be noted that the research methodology is based on the following concepts: constructivism: learning is considered as a process of active construction of knowledge through interaction with digital technologies; iterative approach: constant improvement of educational materials and methods based on the results of their implementation; digital pedagogy: integration of innovative educational technologies for the formation of critical thinking, creative approach and independent learning of knowledge.

Results: Natural sciences are the basis for the development of high technologies, medicine, ecology, energy and agricultural sectors. They contribute to critical thinking, the ability to work with data and predict future changes. In the face of global challenges such as climate change and environmental pollution, science education plays a key role in preparing responsible citizens. Neural networks are changing approaches to learning, allowing for the personalization of the educational process.

Table 1: **Main directions of implementation of neural networks in education**

№, s/n	Direction	Features of implementation
1.	Adaptive learning	creation of individual learning routes depending on the student's abilities and needs.
2.	Intelligent educational platforms	interactive environments that help students master complex concepts through interaction with digital models.
3.	Automatic assessment of knowledge	using AI to analyze answers and determine the level of preparation.
4.	Modeling of scientific processes	conducting virtual experiments and simulations.

Iteration of neural networks involves constant improvement of algorithms based on the received data. In the context of education, this means that learning platforms are becoming increasingly intelligent, adapting to changes in students' knowledge.

Modern neural networks and AI algorithms are actively changing approaches to teaching natural sciences. They allow for process modeling, analysis of large data sets, and creation of adaptive educational environments [2].

When studying genetics and bioinformatics, neural networks are used to analyze genetic information, predict mutations, and decipher complex relationships between genes, thereby enabling students to analyze DNA and identify potential genetic abnormalities, use bioinformatics algorithms to identify connections between hereditary diseases and genetic mutations, and create personalized medical recommendations based on genetic data.

In the conditions in which Ukraine finds itself, ecological research and the study of the impact of these changes on biodiversity are becoming quite important. In turn, neural networks help predict climate change based on the analysis of satellite data, assess the risks of species extinction by analyzing population trends, and optimize measures to preserve biodiversity.

Pharmacology and biochemistry are fundamental sciences that study chemical and biological processes in living organisms. They are of great importance for medicine, biotechnology, agricultural sciences, and the pharmaceutical industry. Modern research in these fields actively uses methods of neural network analysis, which allows to improve the efficiency of scientific discoveries and optimize the processes of drug development. In these fields, neural networks allow to identify new drugs using simulations of chemical reactions, predict the effectiveness of drugs by modeling their action at the cellular level, analyze the interactions of molecules, and create new biologically active compounds [4].

Table 2: **Application of neural networks in individual branches of natural science education**

№, s/n	Branch of natural sciences	Possibilities of application of neural networks
1.	Chemistry	use of neural networks to predict possible outcomes of chemical reactions; optimization of synthesis of new substances, in particular medicines; automation of the process of analysis of complex chemical compounds.
2.	Geography and geology	creation of dynamic maps from satellite images; forecasting of landscape changes under the influence of natural and man-made factors; automated recognition of geological structures from satellite images; identification of regularities in the occurrence of earthquakes and tsunamis, modeling of the impact of natural disasters on infrastructure and the environment.
3.	Hydrology and meteorology	analysis of climate change based on long-term data; forecasting of floods and other natural disasters, optimization of water resources through the analysis of hydrological processes.
4.	Ecology and agricultural sciences	forecasting of greenhouse gas emissions; modeling of ecological systems and assessment of the impact of human activity on the biosphere; automation of monitoring the condition of forests, water bodies and other natural resources; optimization of farming methods using predictive models; analysis of soil condition and recommendations for fertilizer application; use of drones with AI to monitor yields and crop condition.

Physics and astronomy as branches of natural sciences are very important for the formation of a holistic scientific picture of the world. They have common methodological

foundations and widely use mathematical modeling, experimental research, and modern computing technologies, including neural networks. After analyzing recent research, we can note that the development of neural networks has significantly simplified the analysis of physical processes, in particular, modeling quantum effects and predicting the behavior of particles in complex physical systems, visualizing gravitational waves and predicting their impact on space objects, and has helped and made possible the automated analysis of experimental data used in physical research, the detection of exoplanets based on the analysis of changes in the brightness of stars, etc. Some areas of application of neural networks in natural cycle research are presented in the table [5].

Let's take a look at the main services using artificial intelligence to improve the acquisition of natural science competencies when studying the disciplines of the natural cycle.

AI services create interactive virtual laboratories where students can experiment without the need for physical materials or laboratory equipment. For example, platforms like Labster and PhET Interactive Simulations allow you to simulate chemical reactions, biological processes, and physical phenomena in a safe environment. Such simulations also allow you to recreate conditions that are difficult to create in real laboratories, for example, research in the field of genetics or astrophysics [1].

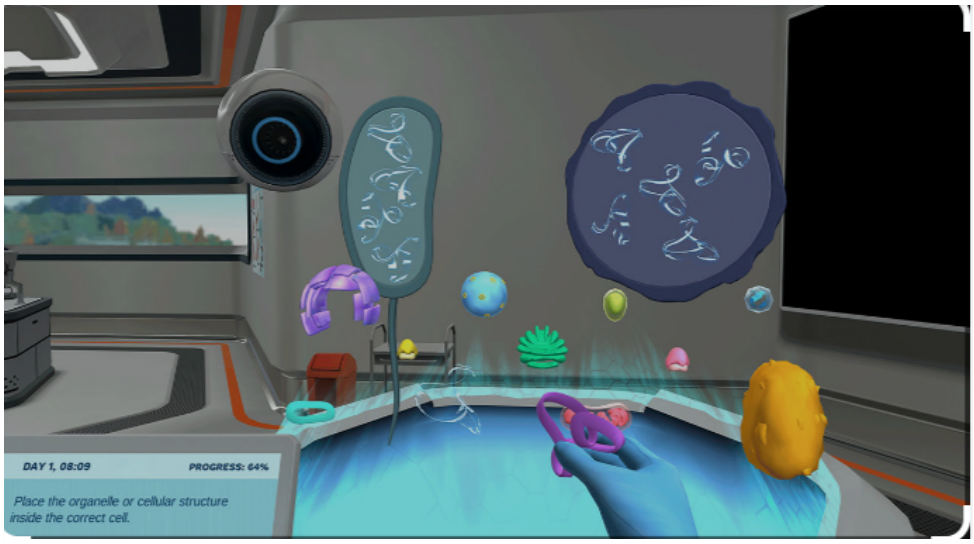

Figure 1: **Fragment of using the Labster platform**

AI services are able to adjust educational materials according to the needs and level of knowledge of the student. Platforms such as CenturyTech and Smart Sparrow analyze the student's progress and offer tasks according to his successes and weaknesses. This helps students learn the material at their own pace and makes learning more flexible and individual [3].

For the study of biology, ecology and other sciences, AI is able to analyze images with high accuracy, which is extremely useful in the study of wildlife. For example, PlantNet is an application that recognizes plant species from photographs, which is especially useful for botany and ecology. AI systems can analyze microscopic images, which helps students study cell structure, viruses and bacteria, contributing to a deeper understanding of the material [7].

Voice assistants like Google Assistant, Alexa, or specialized learning bots like Socratic can answer students' questions, explain concepts, and provide additional materials. This allows you to get answers to your questions quickly and make the most of your learning time. Copilot is an artificial intelligence tool powered by GPT-4, developed by Microsoft

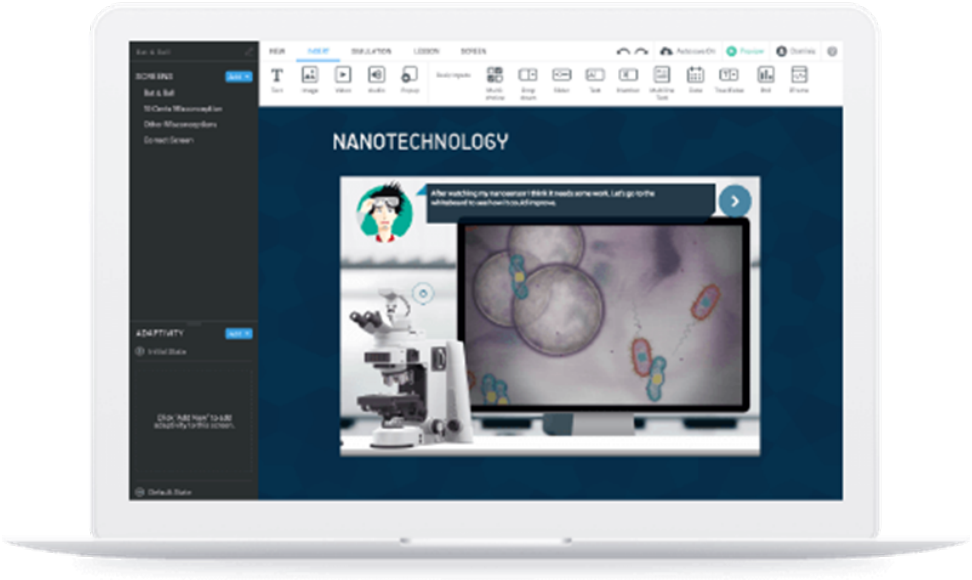

Figure 2: **Fragment of the use of the Smart Sparrow platform**

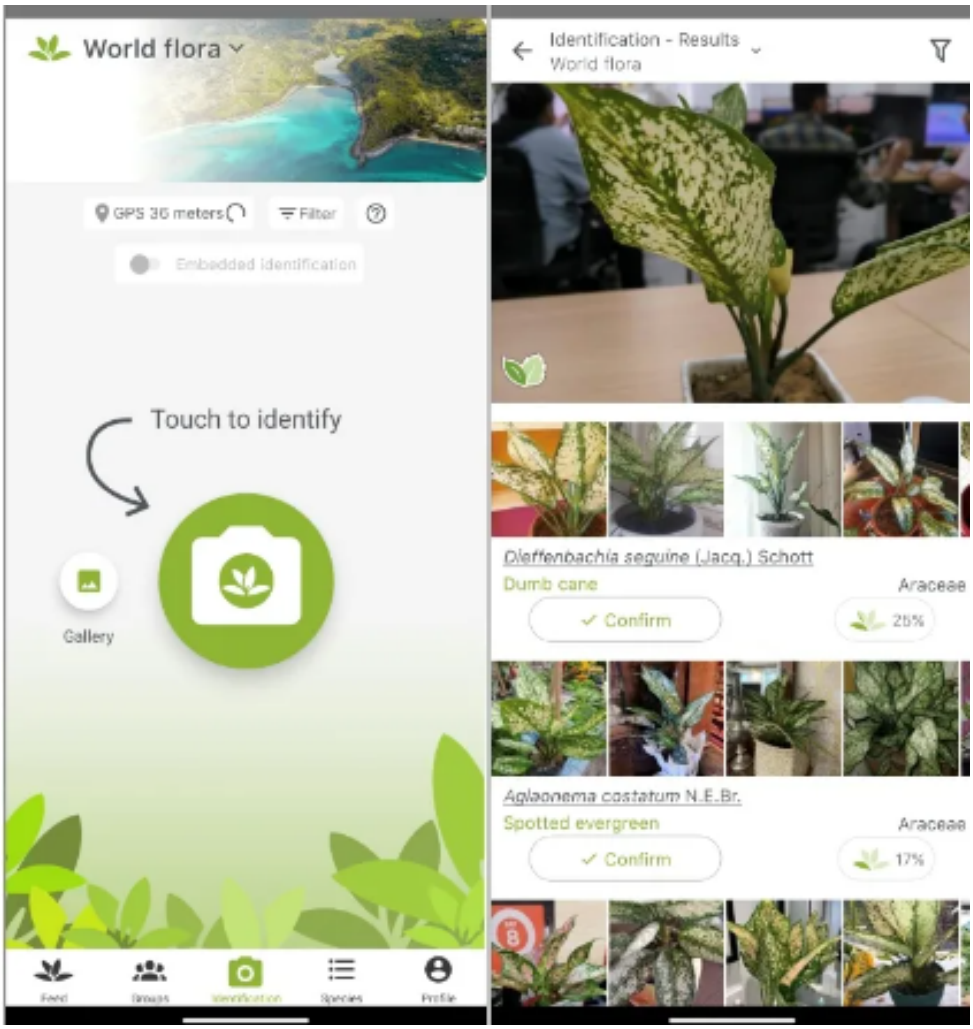

Figure 3: **Fragment of using the PlantNet**

in collaboration with OpenAI for Windows 10 and 11, Microsoft 365, and the Microsoft Edge web browser. Copilot on Windows uses your data to help it formulate relevant

answers to your queries. For example, this data could be the words you type or speak when interacting with Copilot on Windows, or it could be the page you view in Microsoft Edge [6].

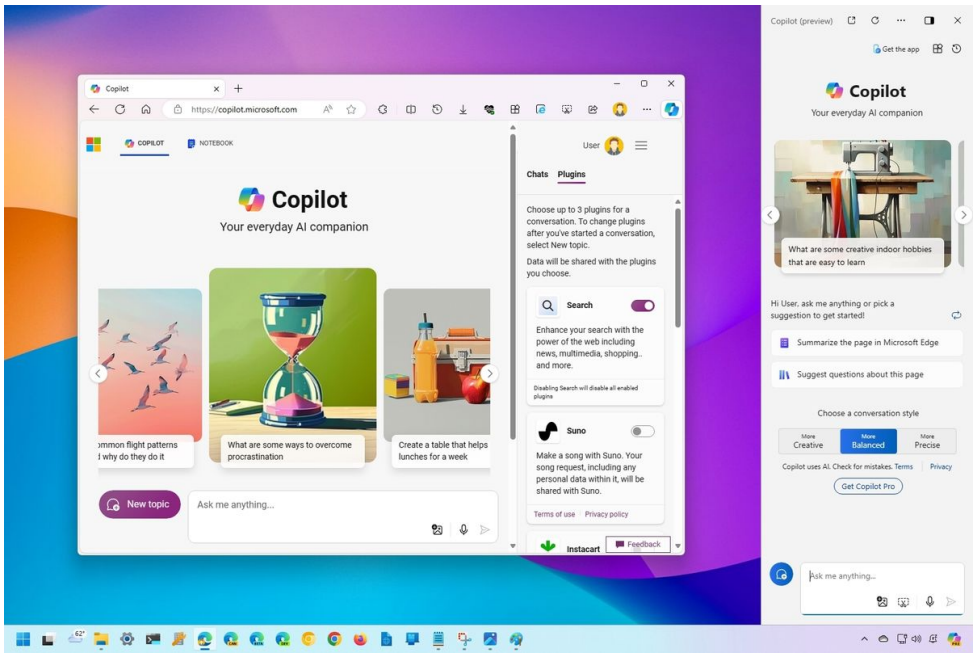

Figure 4: **Copilot interface**

Perplexity is an artificial intelligence search engine and assistant. It is a conversational search engine, like an "answer system", that responds to queries using intelligent text in natural language. Launched in 2022, Perplexity generates answers using sources from the Internet and cites links in the text response.

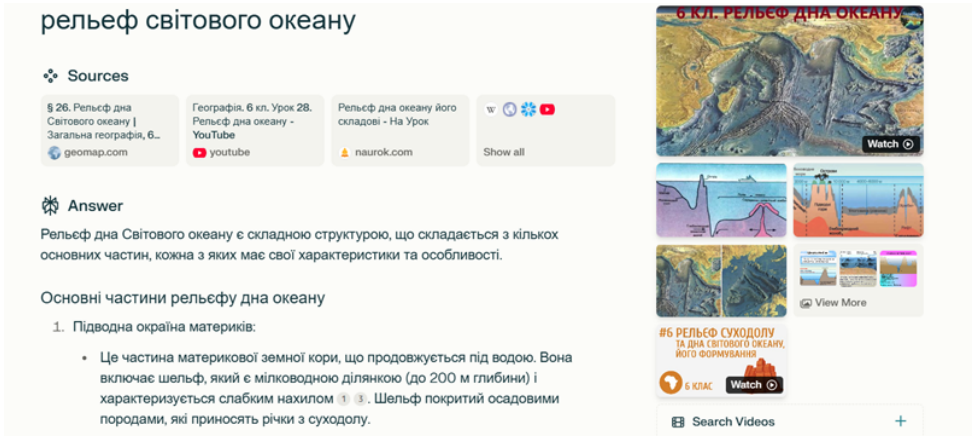

Figure 5: **Perplexity program interface**

Conclusions: the introduction of neural networks into science education allows us to significantly improve the educational process, making it more interactive, personalized and effective, opening up new horizons. The use of artificial intelligence in the study of science disciplines allows us to analyze large data sets, predict natural phenomena, automate research and model complex processes. Thanks to this, students get the opportunity to work with the most modern technologies and acquire the skills necessary for successful scientific and professional activity in the 21st century.

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