

## СЕКЦІЯ: ІННОВАЦІЙНІ ТЕХНОЛОГІЇ НАВЧАННЯ В ЗАКЛАДАХ ОСВІТИ

### VISUALIZATION TOOLS IN TEACHING

#### **Birkovyi Maksym**

Applicant for the first level of higher education in the specialty of Secondary Education  
(Informatics)

Ternopil Volodymyr Hnatiuk National Pedagogical University  
birkovyi\_my@fizmat.tnpu.edu.ua

#### **Skaskiv Hanna**

Assistant of the Department of Informatics and Methods of its Teaching  
Ternopil Volodymyr Hnatiuk National Pedagogical University  
skaskivg@tnpu.edu.ua

In the context of the digital transformation of education, the use of visualization tools as an effective means of improving the quality of the learning process is becoming increasingly relevant. Visual elements contribute to a deeper understanding of complex concepts, the development of critical thinking, and the formation of lasting motivation to learn. They allow teaching materials to be adapted to different styles of information perception, which is especially important in the context of inclusive education.

The issue of visualizing educational content is being studied in both national [2; 4] and foreign pedagogy. Among Ukrainian scientists, it is worth noting O. Pometun [3], N. Morze [2], and V. Rybalko [5], who analyze interactive teaching methods and the role of ICT in the formation of competencies. In global practice, significant contributions have been made by R. Mayer in researching the theory of multimedia learning, J. Bruner in the concept of spiral learning, as well as researchers in cognitive psychology who study the influence of visual stimuli on memorization and understanding [1]. Research on the effectiveness of AR/VR technologies, personalization of visual content, and its adaptation to the age and cognitive characteristics of students remains relevant.

Visualization tools in education are divided into different types, depending on which aspect of the learning process they improve and which skills they activate in students. The main types of visualization tools can be classified as static and dynamic, each of which has its own characteristics and applications depending on the subject, age group of students, and learning objectives.

Static tools are those that do not change over time:

- Tables and graphs allow you to systematize and compare data.
- Diagrams visualize logical and causal relationships.
- Illustrations and drawings promote the development of visual thinking.
- Presentations provide a structured presentation of material.
- Dynamic tools include elements of movement, interaction, or animation:
- Animations demonstrate complex processes.
- Video lessons combine visual elements to make the material accessible.
- Interactive simulations allow students to experiment in a virtual environment.

- 3D models allow objects to be explored in three-dimensional space.

Modern visualization technologies significantly expand the possibilities of visualization:

- Augmented reality (AR) combines real and virtual space.
- Virtual reality (VR) creates an immersive effect.
- Interactive whiteboards and touch screens ensure active student participation in learning and integrate interactive content in real time.
- Static visualization tools are characterized by elements that do not change, they do not have animated or dynamic components.

Tables and graphs are one of the most common and effective ways to present information in the learning process. With the help of tables, students can systematize data and compare values and characteristics. Graphs help to visually represent the relationships between quantitative indicators, which allows for a better understanding of changes or patterns in the educational material. For example, studying statistical data, economic processes, experimental results, or physical measurements using graphs simplifies the process of analysis and drawing conclusions.

Diagrams are used to visualize logical, cause-and-effect relationships between elements of a particular system. They can be applied in various fields of study: from mathematical problems to historical or literary analysis. With the help of diagrams, students can clearly see the structure of something complex – for example, the structure of ecosystems, the organizational structure of a company, or processes in the human body.

Illustrations and drawings are an important tool in teaching, especially in art, biology, geography, geometry, and physics classes. Illustrations can help children better understand what natural objects, various historical events, or phenomena they have not yet encountered look like. They promote the development of visual thinking and complement textual information, increasing the effectiveness of memorization.

**Presentations** – Presentations are a convenient tool for presenting large amounts of information in a structured way. They combine text, graphics, illustrations, and even videos in a single format, making them interactive and multifunctional. Presentations are used not only to present material, but also to organize knowledge checks, demonstrate complex concepts, and provide feedback during the lesson.

Dynamic visualization tools differ from static ones in that they include elements of movement, interaction, or animation, which allows for a deeper understanding of the phenomena or processes being studied. This significantly increases student engagement in the learning process.

Animations are a powerful tool for demonstrating processes that cannot be seen directly. They allow you to visually show how various phenomena occur, from molecular reactions in chemistry to the mechanisms of motion in physics. Animations help visualize temporal and spatial changes, giving students a deeper understanding of how various processes occur. For example, animations showing the movement of planets or blood circulation in the body can greatly facilitate the understanding of complex processes.

Video lessons and educational videos are an excellent means of conveying knowledge on various topics, as they allow you not only to see and hear the material, but also to visually demonstrate principles, techniques, and methods. Video lessons can be

recorded by teachers or professionals in a particular field and may include practical exercises, experiments, or explanations of complex theories. They provide a high level of accessibility to the material and can be used as preparation for a lesson, during a lesson, or as a supplementary tool after a lesson to reinforce knowledge.

Interactive simulations are one of the most exciting forms of dynamic visualization. This software allows students to interact with educational material, conduct experiments in a safe virtual environment, and explore various phenomena. For example, simulations of physical experiments, where students can change conditions and observe the results, significantly increase their interest and help them better understand the principles of certain systems.

The use of 3D models opens up great opportunities for interactive learning, especially in areas where it is important to see objects in three-dimensional space. These can be models of organisms, buildings, technical devices, or even space systems. With the help of 3D models, students can rotate, scale, and explore the details of objects from different angles, which allows them to gain a deeper understanding of their structure and functioning.

In addition to traditional visualization tools, new technologies have gained popularity in recent years, expanding learning opportunities and significantly increasing interactivity.

Augmented reality (AR) is a technology that combines the real and virtual worlds, allowing users to “see” virtual objects superimposed on the real environment. For example, with AR, students can study the structure of organisms when a 3D model of an organism appears on the screen of a tablet or smartphone, which can be rotated and examined from different angles. This technology makes learning more interactive and promotes the development of creative and analytical skills.

Virtual reality (VR) – virtual reality allows students to fully immerse themselves in the learning process, creating the impression of being present in another space or time. VR technologies are actively used to conduct virtual tours, simulate physical phenomena, and create educational laboratories where students can perform experiments in a safe environment. This allows for the creation of realistic conditions for studying complex topics such as medicine, architecture, ecology, and many others.

Interactive whiteboards and touch screens – these visualization tools allow traditional teaching methods to be integrated with modern technologies. Teachers can draw, write, or manipulate data in real time on the board, while students can interact with the content using touch screens, which allows each student to be actively involved in the learning process.

Thus, the use of various visualization tools, from static to dynamic, allows you to create a multi-layered and diverse learning environment that is maximally adapted to the needs of students. The use of such tools not only improves understanding and memorization of material, but also contributes to the development of creative and critical abilities, as well as significantly increases students’ motivation to learn.

Visualization in the learning process is a powerful tool that significantly improves the effectiveness of information assimilation and develops critical thinking, creativity, and analytical skills in students. The successful integration of visualization into the educational process contributes to the creation of an inclusive, dynamic, and effective learning environment.

### References

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## PROFESSIONAL DEVELOPMENT OF TEACHERS IN EDUCATIONAL INSTITUTIONS

**Vasylenko Oksana**

Associate Professor Anhalt University of Applied Sciences

Anhalt University of Applied Sciences

oksana.vasylenko@hs-anhalt.de

**Henseruk Viktor**

Postgraduate student, specialisation Educational and Pedagogical Sciences

Ternopil Volodymyr Hnatiuk National Pedagogical University

viktern@ tnpu.edu.ua

The professional self-development of higher education teachers is an important subject of scientific and pedagogical research, as it directly affects the quality of education, the professional competence of teachers and their ability to adapt to modern challenges. This process covers a wide range of aspects, including teachers' motivation for self-development, methods of professional development, the use of digital technologies in professional growth, and the impact of self-development on teaching effectiveness.

Professional self-development is the process of consciously improving one's knowledge, skills, competencies, and personal qualities in order to increase effectiveness in professional activities and achieve career goals. It involves active learning, adaptation to changes in the work environment, the development of critical thinking, a creative approach, and the ability to self-reflect.

The issue of professional self-development of higher education teachers has attracted the attention of many scholars, particularly in Ukraine and abroad. The conceptual foundations of the theory of professional self-development are highlighted in the works of I. Ziazun, L. Vygotsky, O. Kochetov, S. Rubinstein and others. This issue is also covered not only in scientific works, but also in international and domestic recommendations and regulatory documents [1, 2].

The main components of professional self-development are:

1. Self-education — studying new technologies, methods, literature or courses related to the professional field.