ENHANCING PROFESSIONAL FOREIGN LANGUAGE LEARNING THROUGH VISUALIZATION TECHNOLOGIES

ВДОСКОНАЛЕННЯ НАВЧАННЯ ФАХОВОЇ ІНОЗЕМНОЇ МОВИ ЗА ДОПОМОГОЮ ТЕХНОЛОГІЙ ВІЗУАЛІЗАЦІЇ

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Pryshupa Yu.Yu.,
PhD, Associate Professor,
Associate Professor at the Department of Foreign Languages and Translation
National Aviation University

Konoplianyk L.M.,
PhD, Associate Professor,
Associate Professor at the Department of Foreign Languages and Translation
National Aviation University

The article deals with the special features of using visualization technologies for better comprehension of learning material while learning professional foreign languages in a higher education institution. The authors highlight the peculiarities of the process of thinking of the modern digital generation. Much attention is paid to visualization technologies that facilitate the perception of learning material, provide its appropriate understanding and compact information flows that imitate the essence of the subject of knowledge and where didactic material can be presented as a combination of different forms: a text, a sound, graphics, an animation, a photo, and a video. It has been determined that visualization technologies of educational information are a system that contains a complex of educational knowledge, visual methods of their representation, technical means of information transmission, and psychological methods of using and developing visual thinking in the learning process. The article analyses digital tools for information visualization in the form of slide shows, virtual journeys, infographics, interactive models, and digital didactic games. These forms are convenient and easy to use since they contain comprehensive visual material, and can be adjusted to screens of any size, from smartphones to computers. It has been established that virtual and augmented reality technologies, gamification, and mobile learning expand the concept of education, facilitate better comprehension of a learning material by students and promote further integration of knowledge and cultural exchange. This leads to a more dynamic and interactive learning process, which increases the effectiveness of professional foreign language acquisition. This aspect is important in the context of the digital transformation of education, as foreign language proficiency opens up new perspectives for personal development and professional progress.

Key words: *visualization, visualization technologies, professional foreign language, information and educational environment, augmented reality, gamification, infographics, mind map.*

У статті розглядаються особливості використання засобів візуалізації для кращого засвоєння навчального матеріалу під час вивчення іноземних мов у закладах вищої освіти. Висвітлюються особливості мислення сучасного цифрового покоління. Значну увагу приділено програмним засобам візуалізації для полегшення сприйняття навчального матеріалу, забезпечення його правильного розуміння та ущільнення інформаційних потоків, що імітують сутність предмета пізнання, і на яких дидактичний матеріал може бути подано одночасно в комбінації різних форм: текстових, звукових, графічних, анімаційних, фото і відео. Визначено, що технології візуалізації навчальної інформації це система, що містить комплекс навчальних знань, візуальні способи їхнього представлення, візуально-технічні засоби передачі інформації, психологічні прийоми використання та розвитку візуального мислення в процесі навчання. Проведено аналіз засобів візуалізації навчальних даних за такими формами як: слайд-шоу, віртуальних подорожей, інфографіки, інтерактивних моделей, та цифрових дидактичних ігор. Зазначені форми зручні та прості у використанні, містять багатий візуальний матеріал та підлаштовуються до екранів будь-якого розміру: від смартфонів до комп'ютерів. Встановлено, що технології віртуальної та доповненої реальності, гейміфікація та мобільне навчання допомагають розширити концепцію освіти, розвивають комунікативні навички студентів та сприяють подальшій інтеграції знань та культурному обміну. Це призводить до більш динамічного та інтерактивного процесу навчання, що в свою чергу збільшує ефективність засвоєння іноземної мови. Цей аспект має важливе значення в контексті цифрової трансформації освіти, оскільки володіння іноземною мовою відкриває нові перспективи для особистісного розвитку та професійного зростання.

Ключові слова: *візуалізація, технології візуалізації, фахова іноземна мова, інформаційно-освітнє середовище, доповнена реальність, гейміфікація, інфографіка, ментальна карта.*

Problem statement**.** The transformation processes associated with the information revolution and education system modernization result in conceptual changes in the objective, content, and technological foundations. The level of implementation of the technological approach is one of the most crucial criteria to determine the competitiveness and prestige of a higher educational institution, as educational technologies ensure consistency, purposefulness, and efficiency of its activities [9]. These changes have affected both the education system as a whole and the educational environment of higher education institutions, having a significant impact on modern students who are significantly different from the previous generations in terms of digital literacy and ability to quickly adapt to new information flows. Modern students have clip thinking and perceive the world as a series of virtually unrelated events and facts, as well as they think globally and spend more time with digital devices than with their peers.

The prevalence of various digital devices and the innate proficiency in their usage are not the only distinguishing factors among contemporary students. Their experiences are significantly shaped by the omnipresence of abundant and intense information overload, and the pervasive authority of social networks, which they encounter from an early age and have continuous access to [1]. Unlike any previous

generation, they have an abundance of quickly and easily accessible information.

Today's world of information overload, which is supposed to increase the intelligence of the young generation, often has the opposite effect, as young people do not have time to process, assimilate and use the incoming information. Due to information overload, it is difficult for students to focus on the main aspects of their professional training, which affects its quality. Nowadays, foreign language proficiency is not only a prerequisite for professional development but also a key to cultural enrichment and international communication. However, information overload can hinder deep language acquisition, as students may have difficulties focusing on complex language structures and cultural nuances that require more time and attention to be understood.

Since the amount of information has grown incredibly and continues to grow permanently, new technologies of visualization and transmission have emerged. The formation of a new visual culture of society has a powerful impact on education. Accordingly, there is an urgent need to use visualization technologies of educational information to improve the quality of education. In this regard, the role of visual models of educational information presentation has increased, which helps to overcome the difficulties associated with learning [3, p. 174].

Taking into account that the nature of perception and learning by the modern generation differs from that of previous generations, they require radical changes in the methods of presenting information. The representatives of a new generation rarely read the text, and their reading method can be more described as skimming. Furthermore, they seek independence from the teacher in learning and constant access to the digital environment to which they are accustomed and which they use constantly. Thus, the requirement for visual representation of educational content is becoming crucial for the modern education system [3, p. 175]. In this context, educators and researchers are compelled to explore new approaches to language teaching which include the introduction of visualization technologies. This approach can assist students in managing information overload more adeptly, focusing on important aspects of the language and proficiently applying language skills in practical settings.

Review and analysis of recent research and publications. Researchers in Ukraine and abroad have shown a keen interest in the application of modern visualization technologies in education, as evidenced by the analysis of psychological and pedagogical literature. Various scholars have contributed to this field, including Asmolov O., Bartlett F., Verbytskyi A., Davydov V., Kalmykova Z., who have investigated the theoretical foundations of visualization of educational information; Stanka L., Stanka R., Felea C., Pintea M. [12], Lengler R., Eppler M. [11], Sharma A., and Chauhan S., Zimmermann W. [13], who have devoted their research papers to knowledge visualization and its contribution to creating conditions for personalized learning. Lengler R. and Eppler M. have proposed a classification system for visualization methods applicable to educational information [11]. Researchers such as Holub T. and Sirakaya M. have investigated the role of immersive technologies in visualizing educational material. Bilousova L., Zhyteniova N., Holub T., Kriukova Ye., Kovalenko O., Denysenko S., Shkarban I., Koval T., Besklinska O., Herasimova S., Koibichuk V., Margolina I., Neudakhina N., Mansurov O., Soboleva A., and Starychenko B. have revealed the special features of using visualization in the educational process in a higher school and have focused on the didactic aspects of visualization technologies. They developed original methods for visualization of educational materials and explored new ways to integrate visualization into teaching specific academic disciplines.

Highlighting previously unresolved aspects within the overall problem. Thus, the areas that have been researched recently include theoretical frameworks, personalized learning, classification of visualization methods, immersive technologies, and didactic aspects/methodologies of visualization in education. These studies collectively contribute to understanding how modern visualization technologies can enhance teaching and learning processes. However, several areas within the use of visualization technologies in learning professional foreign language requires further investigation including the issue of modeling a system of methodological tools for compacting the content component of professional foreign language learning in a higher education institution because of an increase in the amount of learning material, the mastery of which requires the correct selection and presentation of information to solve specific educational tasks.

The **objective** of this article is to investigate modern technologies used to visualize educational information (a content component of professional foreign language learning), analyze the prevailing technological trends in visualization within the modern information and educational environment, and reveal the possibilities of their application for visual representation of information in professional foreign language classes.

Main part. The development of the education system requires the study and implementation of modern technologies and new teaching methods. Taking into account the peculiarities of the modern digital generation, who have fundamentally different ways of receiving, perceiving, and learning information, whose ways of thinking and understanding have changed as compared to previous generations (they are unable to perceive large amounts of information,

they have difficulties in perceiving information presented only in a verbal form, their clip thinking is aimed at a vivid visual image), we will pay special attention in our article to modern visualization technologies that allow the teacher to take into account the above-mentioned features and present the learning material in a convenient visual form. In addition, when teaching a professional foreign language, visual technologies stimulate creative thinking and contribute to the development of students' creative skills, which increases motivation and contributes to their professional success.

The quickly developed visualization technologies have led to the emergence of new methods and ways of visualizing learning material and creating a special virtual learning space. At the same time, the increase in the amount of educational data requires the correct selection and presentation of information to solve specific learning tasks. Students should not only learn a certain set of knowledge but also acquire skills that will help them quickly integrate new elements into their knowledge system in the future. This is facilitated by introducing new technologies for presenting educational content, especially technologies for providing visualized information and forming visualized knowledge.

Learning a professional foreign language can be both interesting and effective when visualization is applied. It plays a key role in information perception and memorization, which is particularly important when a language becomes the object of study. Firstly, visualization aids in creating associations between professional terms and their meanings. For instance, images of objects or scenes can aid in understanding the meaning of a word and facilitate its memorization in the relevant context. Secondly, visualization assists in forming associations with grammatical structures and language rules. Schemes, diagrams, and infographics can illustrate grammar rules, making them easier to internalize. Thirdly, visualization promotes the development of creativity and associative thinking. Creating drawings, diagrams or multimedia presentations on language learning topics allows students to express their ideas and understanding of language concepts creatively. In addition, visualization can be useful in learning cultural aspects of a language. Images of architecture, traditions, etc. lead to a better understanding of the context in which the language is used and broaden the students' horizons, and develop their intercultural skills. Thus, visualization is a powerful tool that helps to effectively and engagingly learn a professional foreign language. It fosters both a deep understanding of the language and the development of skills necessary for linguistic competence.

Let's take a closer look at visualization. The concept of "visualization" was introduced by Carl Gustav Jung in the early XXth century as a property of human consciousness to create optical images of the surrounding reality based on human imaginative thinking. Subsequently, various definitions of this phenomenon were formulated with clarifications that have significant differences. This term has become widely spread in psychology, pedagogy, marketing, management, medicine and other areas of human activity.

In the reference literature, "visualization" (*from Latin "visualis" – visual*) is most often interpreted as a visual representation of data; a representation of a physical phenomenon or process in a form convenient for visual perception; a presentation of information in the form of an optical image (drawings, photographs, graphs, diagrams, structural diagrams, tables, maps, etc) [5, p. 20].

Derivatives of this interpretation are the definition of visualization as a method of visual representation aimed at deepening the understanding of information, its processing and creative interpretation, which is widely used in educational activities; as well as consideration of related concepts of technologies and visualization strategies as components of learning. According to this interpretation, it is identified with visuals and acts as a means or form of information presentation.

Thus, researchers consider visualization as the process of forming an image in the student's mind and/or bringing it out with the help of images or videos [13]. This process converts mental content into a visual image, which, once perceived, can be expanded and serve as a basis for adequate mental and practical actions [6]. Visualization of learning material stimulates students to generalize and clarify perceived images, ensuring the completeness and integrity of their perception [6].

Lengler R., Eppler M.J. define visualization as a dynamic and/or static graphical representation of information that stimulates the processes of thought generation, simplifies the analysis of complex concepts, aims at theoretical generalization and analysis of practical experience based on systematicity and consistency due to the compaction of knowledge and models of its representation [11]. Holub T., Kryukova Ye., and Kovalenko O. state that knowledge visualization provides information in the form of an organized set of graphic symbols in a more complex structural relationship between individual information nodes, where, as a rule, information visualization is defined as the transformation of data into the form of graphs, diagrams, drawings or animated sequences [3, p. 175].

Information visualization technologies constitute a comprehensive system that includes a set of educational knowledge, visual methods of presentation, visual and technical tools for transmitting information, as well as psychological approaches for utilizing and enhancing visual thinking during learning [2, p. 12]. Grounded on

the significance of visual perception and the leading role of imagery in cognitive processes and awareness, these technologies aim to prepare students and their consciousness for visualized world conditions and to augment information processing capacity. The study of the results of using diverse forms of information visualization in education reveals several beneficial effects, including heightened and sustained attention among students, enhanced perception and retention, and increased motivation and engagement in the subject matter [3, p. 175].

The most common methods of visualizing the content component of the professional foreign language are as follows:

1. *Mind maps* are diagrams for graphical representation of information, ideas, and concepts, organized around a central theme. The central idea or main topic is placed in the center of the mind map, with related ideas branching out from it. Associative visual and graphic images are important organizing links in the design of conceptual or categorical links in the structural and semantic organization of lexical material on a particular topic while learning a foreign language. [10, p. 194]. Mind mapping transforms the process of articulating thoughts into an engaging activity, distinct from boring note-taking. This is particularly crucial for contemporary youth, as they face the dual challenge of memorizing vast quantities of information and fostering creativity to generate new ideas. Mind mapping makes expressing thoughts interesting, not like boring notes, which is important for today's youth, because they must not only memorize a huge amount of information but also be able to generate ideas [3, p. 176]. Mind maps are commonly used for brainstorming, note-taking, problem-solving, planning, organizing information, and studying because they offer a flexible and intuitive way to capture and visualize complex information, facilitating creativity, analysis, and comprehension.

2. *Infographics* is a graphical visual representation of data or information, serving as effective models for presenting complex data in a comprehensible way. They assist in proper organization and facilitate simplified understanding. By using visual elements to enhance the ability of the human visual system to see models and processes, it is possible to improve data perception [6, p. 153]. Within this technology tables, diagrams, charts, graphs, and various graphic elements can be used. By the nature of data visualization, infographics are divided into quantitative (graphs, charts, nomograms) and qualitative (diagrams, maps, images, mental maps, diagrams, charts, drawings, graphs) [6, p. 153]. Some of the resources for creating infographics are Canva, Piktochart, Venngage, Easel.ly, Infogram, Google Charts, Visme, Draw.io Pro, etc.

3. A *multimedia presentation* is a set of slides that can contain a text, graphic objects, images, audio, video, animation, etc. Multimedia effects of a presentation allow to focus the audience's attention on the main point and contribute to better memorization of learning material [6, p. 153]. They are mainly used in professional foreign language classes for presenting new grammar material; as self-study materials or revision aids, providing students with opportunities to review key concepts, vocabulary, or procedures outside of class; as part of students' project work, presenting their reports or findings. While explaining learning materials, graphical data, and video fragments can also be used to stimulate cognitive interest and motivation for learning. In presentations, various special effects can be applied to attract students' attention and emphasize the most essential points of explanation.

4. A *timeline* is a graphical representation or visualization of events or processes arranged chronologically along a straight line to visually display the history of a phenomenon, process or event, which can be represented in the form of a text, a picture, or a sound [3, p. 176].

5. *Scribing* is a visual note-taking method that uses a combination of drawings, symbols, text, and arrows to create visually appealing notes. The idea of this method is to use a minimum number of words and instead use a large number of drawings and diagrams to visualize an idea or concept. It can be used to take notes during lectures, create outlines, plan projects, or in general for any situation where it is important to summarize and visualize information. This method is actively used as a tool to improve memory and develop creative thinking and perception of information [10, p. 194]. Scribing is the art of displaying text in pictures, and this process is almost parallel to speech. Thus, this technology displays the key points of educational information and the relationships between them [3, p. 176]. Scribing combines text, images, icons, and diagrams to capture the main points, themes, and discussions as they unfold. Scribing is often used in conferences, workshops, or brainstorming sessions to facilitate communication, capture insights, and foster engagement among participants.

According to the ongoing trend of digitalization of education and the integration of information and communication technologies into the information and educational space, the development of educational visual content by educators and the adoption of visualization methods of learning information by students involves the use of the following appropriate visualization tools and services:

• *for creating slideshows and presentations* (video presentation): animoto.com, prezi.com, canva.com, emaze.com, vcasmo.com, miro.com, slides.com, storyjumper.com, edpuzzle.com, voicethread.com, padlet.com);

• *for virtual travel, creating interactive maps*: dermandar.com, gigapan.com, roundme.com, armchair-travel.com, everyscape.com, stepmap.com, tripline.net, storymap.knightlab.com);

• *for creating infographics, timelines, mind maps, and word clouds*: thinglink.com, cacoo.com, creately.com, genial.ly, piktochart.com, visual.ly, canva.com, info.am, padlet.com, statsilk.com, timeline.knightlab.com, timetoast.com, free-timeline.com);

• *for creating digital didactic games:* learningapps.org, pixton.com, marvelhq.com, kahoot.com, stripcreator.com, wittycomics.com; littlebirdtales.com, storybird. com, digitalfilms.com, animatron.com, puzzleit.org, playbuzz.com, sporcle.com, flashcardmachine.com, classtools.net, wixie.com тощо.

The selection of particular visualization forms, methods, and tools for use in foreign language learning within higher education institutions should be guided by several factors. These include the goal and objectives of the academic discipline, students' traits and interests, their proficiency in visualization techniques, and considerations of the available capabilities of the existing information and educational environment within the institution.

This encompasses the transition to digital devices such as computers, smartphones, and tablets, along with the use of digital platforms and services, data transmission via the Internet, and the storage and processing of information in a digital form. Visualizing educational material offers numerous benefits, including rapid information retrieval, enhanced communication, improved business process efficiency, convenient content consumption, automated processes, etc. In addition, it has profound effects on the social, economic, and cultural aspects of society, altering lifestyles, work patterns, learning methodologies, and leisure activities.

Mobile learning is also a crucial visualization technology in modern education, that can significantly increase the effectiveness of language learning. Its core lies in facilitating learning irrespective of location and employing portable technologies for learning. Particularly relevant amidst the global COVID-19 pandemic and the war in Ukraine resulting in the surge in distance learning, mobile learning technologies provide educational mobility, enabling students to learn on the go and engage in learning activities without constraints of time and space. The ubiquity of learning anytime and anywhere has become a common trend in the information society. Tablets and smartphones have become the most favored and convenient mobile devices for learning, facilitating the dissemination of information through animations and interactive features, thereby rendering the learning process captivating, engaging, and immersive.

The mobile learning environment, incorporating multimedia lessons, up-to-date teaching methods, and knowledge presented in a digital format, is becoming a whole world filled with new opportunities for the student. Beyond merely granting students unlimited access to scientific materials, this transformation alters the very essence of the learning process. Knowledge acquisition, comprehension, and validation undergo a profound shift, unfolding into a fast and interactive experience.

The integration of information and communication technologies in the educational process has equipped educators with a powerful tool. However, countries worldwide persistently grapple with challenging issues of the digitalization of education. These challenges stem from the rapid development of technologies, inadequate financial investments, and a lack of a coherent vision regarding the role of educators leveraging cutting-edge technologies to transform the educational process within and beyond higher education institutions [7, p. 104].

The use of cloud technologies in teaching and learning a professional foreign language makes it possible to create visual didactic teaching aids and adapt them to the learning process. At present, many free services already have ready-made sets of visual didactic tools that allow teachers to create their applications, and for this purpose, teachers do not need to have programming skills, as these services are intuitive, convenient, and easy to use. Today, such popular services include Google Sites, LearningApps, Liveworksheets, BrainFlips, ClassTools, ISLCollective, Wixie, Educaplay, Nearpod, Wizerme, PowToon, Eddpuzzle, and others.

The use of visualization technologies stimulates interest in learning and promotes the development of cognitive interest, as traditional textbooks do not fully meet modern needs. Most of the existing electronic textbooks are often digitized paper versions of materials with minimal interactivity, and the issue of organizing a lesson with maximum benefit is still a challenge to be constantly "in trend", one step ahead, and constantly surprise students. One of the most effective solutions to these issues is augmented reality.

Augmented reality (AR) is an interactive visualization technology that enhances real-world images with virtual elements. Nowadays due to the widespread use of mobile devices, it is enough to download a special application that overlays digital information (e.g., 3D models, video, audio, etc.) on the real-world image captured by the camera, and displays the result on the screen. With minimal hardware requirements (a desktop, laptop, or mobile phone which are available), this technology is accessible to everyone, enabling students to work on projects from home at any time. Augmented reality can make any learning material look like a real object, including illustrations in books, models, diagrams, maps, and drawings. These capabilities demonstrate

how augmented reality can significantly enhance learning, providing faster learning, processing, and creating of vast amounts of information, which has a positive impact on the optimization of the learning process. When it comes to motivating and engaging students in the educational process, gamification must be considered as well. It involves applying gaming practices and mechanisms in non-gaming contexts.

There are numerous games today designed to immerse students in the captivating virtual world, with a focus on learning specific disciplines. Quest games have proved to be excellent tools for learning and practicing new vocabulary in foreign languages. Just one game allows for the absorption from 50 to 150 new words and phrases. Furthermore, the internet hosts numerous services offering gamified learning environments. While some provide pre-made games, others empower educators to create their own ones. Notably, proficiency in programming is not a prerequisite to utilizing these platforms, rendering such software accessible to teachers. Although they are not highly sophisticated gaming environments, they effectively serve the educational objectives.

Such immersive technologies as augmented reality, virtual reality, and gamification expand the content of education, which should be focused on the development and self-determination of the individual and the development of their creative potential. Moreover, it encourages ongoing self-education and personal growth.

A key factor in fostering students' self-education skills is personalized learning, which is defined as the interaction of subjects in the process of mastering the world around them, resulting in the formation of an ideal understanding of another subject, which affects the transformation of the consciousness and behaviour of the learner and the teacher through mutual representation to each other [9].

Thus, the rise of immersive technologies in recent years has led to a growing interest in employing immersive approaches to visualize educational content. Visualization technologies enhance learning by immersing students in virtual environments, thereby emphasizing the significance of visualization in professional foreign language learning. Introducing visualization technologies into education represents a crucial pedagogical strategy, as it provides students with rich sensory experiences necessary for understanding abstract concepts and knowledge. The utilization of these technologies is rooted not only in the concept of immersion but also in principles such as visual modality and complexity, which aim to engage multiple human senses [3, p. 176].

Conclusions**.** In modern education, information and communication technologies play a crucial role, facilitating the storage and transmission of vast amounts of information in a visual form. The visualization tools, ranging from graphics to immersive experiences, are essential to enhance knowledge acquisition among students and, consequently, improve the overall quality of higher education. The integration of visualization technologies offers significant potential for enhancing professional foreign language learning. By employing these tools, educators can create immersive and engaging learning environments that cover diverse learning styles and preferences. Given the cognitive tendencies of the contemporary digital generation, characterized by clip thinking which is focused on the fragmentary perception of visual information, coupled with the advancements in educational technologies and expanded capabilities of information and communication technologies, there is a growing incentive for educators to incorporate visualization in professional foreign language teaching and learning. Through visual representation of language concepts and contexts, students can deepen their understanding of the material and application of language skills in practical settings. Furthermore, the use of visualization technologies promotes collaboration, creativity, and critical thinking among students, preparing them more effectively for the demands of the globalized workforce. Consequently, the incorporation of these innovative tools into language education programs emerges as a crucial strategy for advancing proficiency and competency in foreign language acquisition.

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