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FOCUS ON THE PRINCIPLE OF VISUALITY IN ESP TEACHING

It is highlighted that the core mission of higher education system is to create learning opportunities that can allow students to experience solving real-world and job-related problems to prepare them to become competitive employees.

The authors advocate updating English for Specific Purposes (ESP) content by implementation of methods based on the use of developmental psychology, age-specific physiology, sociology, and up-to-date information and communication technologies as means of teaching.

The article is focused on the importance of realizing the didactic principle of visuality in teaching ESP since it enables using up-to-date visual aids and data visualization techniques to create favorable conditions for facilitating psychological, cognitive and psychomotor personal development, on the one hand. On the other hand, there is a great demand for professionals in different areas able to use the Web and digital tools for communicating, collaborating, doing researches as well as designing various products applying graphical modelling.

It is stressed that the effective use of up-to-date visual aids and visualization techniques allows fostering students' motivation and interest and helps them to develop competencies that match the demands of their real-life environment and meet their professional needs.

The analysis of recent researches is presented to demonstrate versatile possibilities of visual tools considering interdisciplinary relations and prove the effectiveness of visualization for learning/teaching purpose.

The special attention is given to the necessity to identify students' learning styles to foster their psychophysiological features to make ESP learning effective and engaging.

The role of the Internet and computer-based technologies is underlined highlighting their possibilities and effectiveness in teaching ESP to students who major in engineering to meet their professional needs.

The significance of the use of visual aids and visualization techniques in the context of distance learning is focused on and some online software tools are described to make distance classes more interactive and engaging.

Key words: *ESP, visual aids, visualization techniques, didactics, principle of visuality, learning styles.*

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РЕАЛІЗАЦІЯ ПРИНЦИПУ НАОЧНОСТІ У НАВЧАННІ АНГЛІЙСЬКІЙ МОВІ ДЛЯ ПРОФЕСІЙНИХ ЦІЛЕЙ

У статті зазначено, що основною метою системи вищої освіти є створення навчального середовища, яке дає студентам можливість вирішувати проблеми, максимально наближені до їхнього реального життя та професійних потреб, готуючи конкурентоспроможних фахівців.

Автори пропонують оновити викладання англійської мови для професійних цілей шляхом впровадження методів, які базуються на врахуванні психології розвитку, вікової фізіології, соціології та використанні сучасних інформаційно-комунікаційних технологій як засобів навчання.

У статті наголошено на важливості реалізації дидактичного принципу наочності під час навчання англійській мові для професійних цілей, оскільки, з одного боку, це дає змогу використовувати сучасні наочні засоби та технології візуалізації даних для створення сприятливих умов для психологічного, когнітивного та психомоторного розвитку особистості студента, а з іншого боку, як зазначається, існує великий попит на фахівців, здатних використовувати Інтернет та цифрові інструменти для спілкування, співпраці, проведення досліджень, а також для проєктування різноманітних продуктів із застосуванням графічного моделювання.

Наголошено на тому, що ефективне використання сучасних наочних засобів і прийомів візуалізації дає можливість підвищувати мотивацію та інтерес студентів, допомагає їм розвивати компетенції, що відповідають вимогам їхнього реального життя та задовольняють професійні потреби.

У статті представлено аналіз сучасних досліджень, що свідчать про різноманітні можливості використання візуальних засобів з урахуванням міждисциплінарних зв'язків та доводять ефективність їх застосування у навчальному процесі.

Особливу увагу приділено необхідності виявлення стилів навчання студентів задля урахування їхніх психофізіологічних особливостей (індивідуальних рис) для підвищення ефективності вивчення англійської мови для професійних цілей.

Відзначено роль Інтернету та комп'ютерних технологій у задоволенні професійних потреб студентів, які спеціалізуються у галузі інженерії, зосереджуючи увагу на можливостях та ефективності їхнього застосування під час навчання англійській мові для професійних цілей.

Наголошено на важливості застосування наочних засобів і прийомів візуалізації у контексті дистанційного навчання та описано програмні онлайн-засоби, використання яких сприяє більшому залученню студентів до навчального процесу і надає дистанційним заняттям інтерактивності.

Ключові слова: *англійська мова для професійних цілей, засоби наочності, прийоми візуалізації, дидактика, принцип наочності, стилі навчання.*

Problem statement. We live and work today in a rapidly changing, highly mobile and globally connected environment where professionals in different areas have to use the Web and digital content to communicate, collaborate and do researches. They need to gather and analyze data using inquiry and visualization tools or design various products applying graphical and 3D modelling tools. With regard to this, on the one hand, the core mission of our education system is to integrate modern technologies to "create learning experiences that mirror students' daily lives and the reality of their futures". On the other hand, "using these real-world tools creates learning opportunities that allow students to grapple with real-world problems – opportunities that prepare them to be more productive members of a globally competitive workforce" (Atkins et al., 2010: xi–10).

One of the top-priority tasks of teaching English for Specific Purposes (ESP) is updating its content by implementation of fundamentally new technologies (methods) based on the use of developmental psychology, age-specific physiology, sociology, and up-to-date information and communication technologies as means of teaching.

The aim of modern higher education didactics is to provide effective training of future professionals considering their specific needs and personal interests. An important principle of teaching in general didactics is the principle of visuality, developed in the didactics of secondary school and widely used in the pedagogical process of higher education. The essence of this principle lies in the conscious, active perception, comprehension and assimilation of the material, nurturing observation, forming a new social experience, improving the potential of students' psychophysical abilities (Fitsula, 2006: 90).

It is known that the didactic principle of visuality in teaching is based on the cognitive theory of sensation by J. A. Comenius, according to which the authenticity of the acquired knowledge depends on sensuous perception, so the sources of cognition are sensation and experience (Malykhin et al., 2011) and the role of images and sense data is essential in the teaching/learning process.

As the data amount is growing rapidly, the development of scientific fields requires careful selection of the information to be fixed in mind. At the same time, modern students prefer perceiving information from the screen of monitors using different gadgets which allow concentrating their attention by means of dynamic visual row rather than text (Strelnikov, Britchenko, 2013). Since a person receives about 80-90% of information due to the visual channels of perception, and moreover, perception and reproduction of visual information require less time than verbal, visualization techniques are to become an integral part of the curriculum, and thus, realize the didactic principle of visuality.

Taking into consideration the aforementioned, in order to foster learners' motivation and interest, it is necessary to integrate into ESP learning effective use of up-to-date visualization tools and techniques which help them to develop competencies to match the demands of their real-life environment and meet their professional needs.

Analysis of researches. Visualization is characterized as the graphical display of information to provide the viewer with visual means of processing information (Segenchuk, 1997); the graphical presentation of information to provide the viewer with qualitative understanding of the information contents (Ward, 1997); a possibility of perceiving and processing information in a graphical form (Veřmiřovský, 2013).

In the context of education, the purpose of any visualization is to facilitate the knowledge acquisition including idea, concept, fact, algorithm, relationship, etc. For this reason, for effective visualization design it is necessary to identify the learner's knowledge base to interpret and integrate its tools into a learning process (Segenchuk, 1997). Along with that, visualization helps to create real or unreal images in the mind's eye (Rolf, 2013). It is an instructional tool for teachers to make decisions how to teach, an effective way to communicate both abstract and concrete ideas, representing information in a dynamic way, facilitating students' interaction for exploration and understanding (Klerkx et al., 2014: 5).

Concerning engagement time frame visualizations are distinguished as static and dynamic or interactive. Static visualizations are a graph or a diagram or any form of static visualization can serve as an intermediate representation to bridge the gap between domains of knowledge, as a tool to demonstrate multiple representations of concept and show important relationships within a concept (Segenchuk, 1997). They do not change with time and play a limited role in education. Conversely, dynamic visualization can change with time and can be presented as a type of simulation which is defined as a controlled dynamic model of reality, which allows solving instructional problems, repeating scenarios with specific learning objectives, experiencing rare or risky situations or results, and modifying behavior without risking harm (Kaufman, Ireland, 2019). Simulation helps learners to study different subject matters related to mathematics, science or technical disciplines in an applied and integrated manner, explore complex relationships that involve expensive equipment or dangerous experiments, experience problem-solving and realistic training and career skills (Kincaid et al., 2003). Dynamic digital visualizations can be considered as a type of computer-based imagery that represents changes in time or space and allows learners interactivity.

In turn, 3D simulation-based learning is regarded as a new strategy which is integrating into teaching and training of engineering students. The research proved that simulation considerably affects motivation, learning orientation, and performance achievements, meets their psychological needs (Koh et al., 2010).

Dynamic visualizations and animations can be regarded as synonymous; after all, animation is a subcategory of dynamic visualization. Animation is described as "a technical process producing motion illusion in the viewer by sequencing the still images produced in the analogue or digital environment in sequence" (Baglama et al., 2018). It is an effective technique to describe structures, models and engineering concepts, demonstrate technical problems and the ways of their solutions, simulate different processes, create computer modelling of physical effects. Due

to the increasing accessibility of computer tools animation technique is becoming more appropriate and appealing in teaching for professional needs. Consequently, dynamic visualizations play a crucial role in education allowing students to enhance cognitive processes and feel engaged and motivated.

Being universal to the science classroom visualization tools are among the most important technologies for learning in the high school due to their significant role of perceiving, understanding and manipulating three-dimensional spatial relationships for learning and problem-solving in many sciences. The authors present the principles for motivating the use of visualization tools and specify the role of visualization as a cognitive strategy (Stieff et al., 2005).

In the frame of practical applications of visualization in learning foreign languages, it is a vital tool to create artificially any environment. The language teacher has to be able to present linguistic material using effective audio and visual aids. They can be used for communication practice to stimulate speaking (both monologue and dialogue) in different environments and situations. For descriptions to visualize people, objects, processes. For narrating to tell stories or describe different events. For writing to present an idea or a virtual tour of the country, the house etc. (Rolf, 2013).

For enhancing vocabulary knowledge visualization techniques allow students to understand the meaning of unfamiliar words and achieve comprehension of a text. Moreover, they help learners to reach a more impressive number of vocabularies. The use of visual aids makes learning new vocabulary more exciting and engaging because it is much easier to perceive the meaning of unfamiliar words by association. What is more, the use of visual aids in teaching vocabulary makes the lesson more active and alive and fosters the students' curiosity in learning new vocabulary (Ghaedi, Shahrokhi, 2016).

In the context of interdisciplinary relations visualization can serve as an effective tool to model or simulate various problems, tasks, activities and demonstrate different approaches and methods stimulating students to reason and engaging them in a problem-solving process. Using different visualization tools such as concept mapping, mind mapping, diagramming, mathematical modelling, and animation software provides high-quality reasoning in a collaborative way (Ishonqulov, 2017).

Visual expression is an important tool for the presentation of science and technology. Using different images, symbols and diagrams is an integral part of the communication of many professions. Visual teaching motivates students to make progress in learning; moreover, computer technology in cooperation with visualization allows the development of critical thinking (Veřmiřovský, 2013). It was researched, that visualization is an essential component of understanding, and in turn, critical thinking determines the quality of understanding. Since learning relies on the memorization of knowledge, without critical thinking this process is difficult. Applying visualization approach into teaching practices enables educators to enhance students' performance in classes and facilitate communication, make students solve problems and provide an analytical approach to problem-solving increasing critical thinking (Shatri, 2017).

The purpose of the paper. The role of visualization in ESP teaching to students of technical specialties, the variety of its functions to be applied, and methods for solving didactic problems have not been studied enough in pedagogical science and practice. So, the purpose of this paper is to analyze the possibilities of 21st-century technologies and find the most demanded and effective techniques to visualize language learning considering students' interests and professional needs and thus, realize the didactic principle of visuality in ESP teaching to engage, motivate and inspire students as active learners.

Presentation of the basic material. Teaching, in the context of didactics, is regarded, on the one hand as an object of study (study, systematization and generalization of pedagogical experience, its scientific substantiation, explanations based on the laws and mechanisms of psychology and cognitive, psychomotor personal development) and, on the other hand, as an object of construction (i.e., development of a content, effective methods and training tools, designing learning technologies to maximize its effectiveness) (Malykhin et al., 2011; Fitsula, 2006).

Consequently, the process of organizing and carrying out educational and cognitive activity in ESP teaching should involve the use of the visualization methods such as: observation (perception of reality); illustration (presentation of materials in a static form of illustrated manuals (charts, graphs, posters, cards, drawings, etc.)); demonstration (presentation of materials in the dynamic form (demonstration of different processes, work of technical devices, multimedia presentations, experiments, educational video programs, etc.)) that is, the realization of the didactic principle of visuality (Malykhin et al., 2011).

In this context, identifying learners' individual abilities to fix information in their minds in order to optimize their memory is of great importance.

It is obvious that people use five sensory channels with different emphasis. Some individuals are sensitive to visual stimuli while others respond stronger to

auditory or kinesthetic ones. To foster in students the process of memorizing more effectively, the teacher has to recognize the type of memory – visual, auditory, kinesthetic or mixed – each of them has.

Realizing the ideas of students' personal development, identifying their psychophysiological features (traits) in practice and for more effective implementation of the principle of visuality in ESP, it is important to take into consideration students' learning styles.

The concept of learning style developed by Alice Y. Kolb and David A. Kolb describes individual differences in learning based on the learner's preference for employing different phases of the learning cycle (Kolb, Kolb, 2005: 194–195). Learning style is considered to be the most optimal way of perceiving, processing and assimilating educational material.

According to the type of individual's memory (visual, auditory, kinesthetic or mixed) scientists regard visual, auditory and kinesthetic as the basic learning styles. That is why, it is crucial for the teacher to be able to identify the best suiting learning style for every individual.

It is obvious that visual learners need visual support and are better at memorizing information through images, maps, diagrams, graphs, pictures, objects, videos, presentations, etc., whereas auditory learners understand new content better through listening, remember much of what they hear and then say, prefer verbal explanation to a visual demonstration. Kinesthetic learners prefer learning through doing using their senses: touching, feeling, smelling, holding, practical hands-on experiences, they need movement and participation in different activities.

Knowing the type of individual's memory and correspondently peculiarities of students' learning styles, it is possible to properly select the most relevant methods, approaches, educational material and activities to organize ESP teaching in a well-structured and effective manner.

To help visual learners to take in the information a teacher should use relevant illustrations that go with the text. Since visual learners easily remember images rather than words, it is beneficial to incorporate board games or card games to teach vocabulary, grammar, phonetics, spelling, etc. Color coding the notes creates visual stimulation for the better perception of the learning material.

Learning through stories, quotations, audio and video recordings as well as verbal repetition become more engaging and effective means of study for auditory learners.

Kinesthetic learners are considered to be active learners; they need movement and participation in different activities. It is critical to vary activities during each class to keep them involved in the learning process. The best techniques to be applied are role plays, team games, case studies, touch, spatial and craft games that help these students to grasp key concepts (Nazarenko, 2018).

Focus on the use of techniques combining different styles will allow the teacher to organize productive memorizing, as well as developing all types of memory (with any leading type) will distinguish a certain logical structure of perception of the educational material.

Considering specific features of teaching ESP to students majoring in different areas of engineering it is undoubtedly impossible to realize the principle of visuality without Internet and computer-based technologies. These technologies enable designing and integrating a wide variety of media into ESP learning: texts, photos, graphics, diagrams, videos, modelling, animations, simulations, etc. As a result, students are engaged in "deep" interactive learning that provides attention, interest, motivation and helps to avoid boredom in classes.

The Internet and computer-based technologies, engaging learners in real-world problems, facilitate imagination and intellectual curiosity; help them to open new channels for visions of career possibilities allowing students to see themselves in productive professional roles (Atkins et al., 2010: 17).

Providing multiple and flexible methods of presentation of information and knowledge they enable designing different scenarios or content for learning stimulating communication and collaboration in English, developing both technical and transferable skills. As a very effective technical means of learning the technologies influence the visual and auditory analyzers responding promptly to the user actions, maintaining real feedback, i.e. work in interactive mode (Malykhin et al., 2011).

The didactic significance of the Internet and computer-based technologies in terms of visualization of learning processes lies in the possibility of implementation of the principle of visuality allowing us to create an effective, comfortable and friendly environment for teaching ESP modelling visual interactive educational content and approaches.

In the context of distance learning, the use of visual aids and visualization techniques is becoming especially critical. To make distance classes more interactive and engaging it is worth drawing attention to different educational online software tools that can help to create very effective and interactive visual aids in learning ESP and meet the learners' individual abilities and needs.

While teaching ESP to students of the Institute of Telecommunication Systems we could experience

possibilities of Quizlet and some online software tools for creating presentations.

In our online as well as distance sessions we use Quizlet for developing vocabulary, which is one of the most crucial aspects in teaching and developing all four communication skills: reading, writing, listening and speaking, teachers create flashcards to memorize and practice words or expressions related to the topic the students learn. Students can also create their own sets of words to be memorized using visual opportunities provided on the platform. It is possible to design sets of words, specific terms or expressions with relevant illustrations then practice memorizing them as well as their pronunciation. After the stage of memorizing students performs different activities that help learners to identify whether they have memorized vocabulary properly, encourage them to make progress and build confidence. The students can be involved in playing games independently or in teams that allow them to develop their attention, memory and collaborative skills. While learning terms related to different topics or situations they might be involved in everyday life or professional environment, the students develop other skills, such as intercultural understanding or critical thinking skills (Warwick, 2017).

It is worth mentioning that for developing communication and presentation skills, which are badly demanded in telecoms jobs, we use different software tools to create multimedia, digital or video presentations such as PowerPoint as well as its alternatives Google Slides, Prezi, Genially, Bandicam, etc. These applications are free, available on multiple platforms and easily used by students as well as non-technically skilled teachers.

Multimedia presentations have become an integral part of education. They are used to convey information using a slide show format demonstrating text with illustrative materials images, graphs, pictures, animations and embedded videos. The software tools for designing presentations help to build visually appealing, interactive and engaging presentations that foster discussions, create real-time collaboration including chat, comment and review features. They enable creating interactive didactic materials and might be a helpful constructor for creating a unique platform for distance learning. They allow combining video and audio format of information perception with interactive communication. The use of animated text alongside with diagrams, graphs and illustrations helps listeners to focus on the content and memorize the information quicker and better.

Both types of online software tools are able to engage learners with all learning styles and help to develop individual psychological characteristics, memory, attention, etc. Furthermore, these tools allow students to widen their professional thesaurus and broaden their knowledge of specialty.

Conclusions. Keeping in view the challenges of the 21-st century reality and demands for competitive technology specialists, ESP teachers have to create engaging and relevant learning environment that could allow students who major in engineering to develop competencies to meet their real-world and professional needs.

Bearing in mind the possibilities of modern information and communication technologies and effects of psychological, physiological and sociological factors, the realization of the principle of visuality in ESP teaching has a positive influence in terms of motivating students to learn, fostering critical thinking, thus, increasing the quality of understanding.

With due regard to the students' learning styles and interdisciplinary relations the effectiveness of the use of up-to-date visual aids and visualization techniques become obvious:

– technology-based learning resources enable keeping students engaged, developing individual traits and positive attitude to learning, inspiring imagination and intellectual curiosity, and opening new career possibilities;

– students are able to develop the needed technical competencies alongside with transferable skills such as critical thinking, complex problem solving, collaboration and multimedia communication;

– in the context of distance learning the use of online software tools makes distance classes more interactive and engaging;

– visualization techniques allow students to experience "deep" learning engaging them in real-world problems, providing opportunities to communicate, collaborate and express themselves.

BIBLIOGRAPHY

1. Малихін О. В., Павленко І. Г., Лаврентьєва О. О., Матукова Г. І. Методика викладання у вищій школі : навчальний посібник. Сімферополь : Дайфі, 2011. 270 с.

2. Стрельніков В. Ю., Брітченко І. Г. Сучасні технології навчання у вищій школі : модульний посібник для слухачів авторських курсів підвищення кваліфікації викладачів МІПК ПУЕТ. Полтава : ПУЕТ, 2013. 309 с.

3. Фіцула М. М. Педагогіка вищої школи : навчальний посібник. Київ : Академвидав, 2006. 352 с.

4. Atkins D. E. et al. Transforming American Education: Learning Powered by Technology. National Education Technology Plan. Washington, D.C., 2010.

5. Baglama B., Yucesoy Y., Yikmis, A. Using Animation as a Means of Enhancing Learning of Individuals with Special Needs. *TEM*. 2018. № 7 (3). P. 670–677.

6. Ghaedi R., Shahrokhi M. The impact of visualization and verbalization techniques on vocabulary learning of Iranian high school EFL learners. *Gender perspective Ampersand*. 2016. № 3 P. 32–42.

7. Ishonqulov S. U. The Principles of Teaching English as a Foreign Language. *Internauka*. 2017. № 2 (24). P. 20–21.

8. Kaufman D., Ireland A. Simulation as a Strategy in Teacher Education. *Education*. Oxford University Press, 2019.

9. Kincaid J. P., Hamilton R., Tarr R. W., Sangani H. Simulation in Education and Training. *Applied System Simulation* / M. S. Obaidat, G. I. Papadimitriou (eds). Springer, Boston, MA, 2003. DOI: https://doi.org/10.1007/978-1-4419-9218-5_19.

10. Klerkx J., Verbert K., Duval E. Enhancing Learning with Visualization Techniques. Katholieke Universiteit Leuven, Belgium, 2014. P. 5. URL: https://core.ac.uk/download/pdf/34578672.pdf.

11. Koh C., Tan H. S., Tan K. C., Fang L., Fong F. M., Kan D., Lye S. L., Wee M. L. Investigating the Effect of 3D Simulation Based Learning on the Motivation and Performance of Engineering Students. *Journal of Engineering Education*. 2010. № 99 (3). P. 237–251.

12. Kolb A. Y., Kolb D. A. Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Academy of Management Learning & Education*. 2005. № 4. P. 193–212.

13. Nazarenko O. Learning Styles Focus in ESP Differentiated Instruction. Kliuchovi pytannia naukovykh doslidzhen u sferi pedahohiky ta psykholohii u XXI st. [Key issues for research in the field of pedagogy and psychology in XXI st.] : materialy mizhnarodnoi naukovo-praktychnoi konferentsii. L. : HO "Lvivska pedahohichna spilnota", 2019. P. 78–81.

14. Rolf D. An Introduction to Using Visualization. British Council, 2013. URL: https://www.teachingenglish.org.uk/article/introduction-using-visualisation.

15. Segenchuk S. The Role of Visualization in Education. *Computer Science*. Worcester Polytechnic Institute. 1997. URL: https://web.cs.wpi.edu/~matt/courses/cs563/talks/education/IEindex.html.

16. Stieff M., Bateman R., Uttal D.H. Teaching and Learning with Three-Dimensional Representations. John K. Gilbert (ed.) *Visualization in Science Education*. Springer, 2005. P. 93–118.

17. Shatri K. The Use of Visualization in Teaching and Learning Process for Developing Critical Thinking of Students. *European Journal of Social Sciences*, *Education and Research*. 2017. № 4 (1). ISSN 2312-8429 (Online).

18. Veřmiřovský J. The Importance of Visualisation in Education. *E-learning & Lifelong Learning*. 2013. № 1. P. 453–464.

19. Ward M. Overview of Data Visualization. *Computer Science*. Worcester Polytechnic Institute, 1997. URL: https://web.cs.wpi.edu/~matt/courses/cs563/talks/datavis.html.

20. Warwick L. Quizlet Efficient, Engaging, Flashcard Tool. *The Digital Teacher*. Cambridge Assessment English, 2017. URL: https://thedigitalteacher.com/reviews/quizlet.

REFERENCES

1. Malykhin, O. V., Pavlenko, I. H., Lavrentieva, O. O., Matukova, H. I. (2011) Metodyka vykladannia u vyshchii shkoli: navchalnyi posibnyk [Methodology of Teaching in High School: coursebook]. Simferopol: Daifi. 270 p. [in Ukrainian].

2. Strelnikov, V. Yu., Britchenko, I. H. (2013). Suchasni tekhnolohii navchannia u vyshchii shkoli: modulnyi posibnyk dlia slukhachiv avtorskykh kursiv pidvyshchennia kvalifikatsii vykladachiv MIPK PUET [Modern Technologies of Higher Education: modular manual for teachers' training in MIPK PUET]. Poltava: PUET. 309 p. [in Ukrainian].

3. Fitsula, M. M. (2006). Pedahohika vyshchoi shkoly: Navch. posib. [Pedagogy of High School: Coursebook]. K.: Akademvydav. 352 p. [in Ukrainian].

4. Atkins, D. E. et al. (2010). Transforming American Education: Learning Powered by Technology. National Education Technology Plan. Washington, D.C.

5. Baglama, B., Yucesoy Y., Yikmis, A. (2018). Using Animation as a Means of Enhancing Learning of Individuals with Special Needs. *TEM.* 7 (3), pp. 670–677.

6. Ghaedi, R., Shahrokhi, M. (2016). The impact of visualization and verbalization techniques on vocabulary learning of Iranian high school EFL learners: *A gender perspective Ampersand*. 3, pp. 32–42.

7. Ishonqulov, S. U. (2017). The Principles of Teaching English as a Foreign Language. *Internauka*. 2 (24), pp. 20–21.

8. Kaufman, D., Ireland, A. (2019). Simulation as a Strategy in Teacher Education. *Education.* Oxford University Press.

9. Kincaid J. P., Hamilton R., Tarr, R. W., Sangani, H. (2003). Simulation in Education and Training. In: Obaidat M. S., Papadimitriou G. I. (eds.) *Applied System Simulation*. Springer, Boston, MA. https://doi.org/10.1007/978-1-4419-9218-5_19.

10. Klerkx, J., Verbert, K., Duval, E. (2014). Enhancing Learning with Visualization Techniques. Katholieke Universiteit Leuven, Belgium, p. 5. https://core.ac.uk/download/pdf/34578672.pdf.

11. Koh, C., Tan, H. S., Tan, K. C., Fang, L., Fong, F. M., Kan, D., Lye, S. L., Wee, M. L. (2010). Investigating the Effect of 3D Simulation Based Learning on the Motivation and Performance of Engineering Students. *Journal of Engineering Education*. 99 (3). Blackwell Publishing Ltd, pp. 237–251.

12. Kolb, A. Y., Kolb, D. A. (2005). Learning Styles and Learning Spaces: Enhancing Experiential Learning in Higher Education. *Academy of Management Learning & Education*. 4, pp. 193–212.

13. Nazarenko, O. (2019). Learning Styles Focus in ESP Differentiated Instruction. Kliuchovi pytannia naukovykh doslidzhen u sferi pedahohiky ta psykholohii u XXI st. [Key issues for research in the field of pedagogy and psychology in XXI st.]: materialy mizhnarodnoi naukovo-praktychnoi konferentsii. L.: HO "Lvivska pedahohichna spilnota", pp. 78–81.

14. Rolf, D. (2013). An Introduction to Using Visualization. British Council. Retrieved from: https://www.teachingenglish.org.uk/article/introduction-using-visualisation.

15. Segenchuk, S. (1997). The Role of Visualization in Education. *Computer Science*. Worcester Polytechnic Institute. Retrieved from: https://web.cs.wpi.edu/~matt/courses/cs563/talks/education/IEindex.html.

16. Stieff, M., Bateman, R., Uttal, D.H. (2005). Teaching and Learning with Three-Dimensional Representations. John K. Gilbert (ed.) *Visualization in Science Education*. Springer, pp. 93–118.

17. Shatri, K. (2017). The Use of Visualization in Teaching and Learning Process for Developing Critical Thinking of Students. *European Journal of Social Sciences*. ISSN 2312-8429 (Online). *Education and Research*. 4 (1).

18. Veřmiřovský, J. (2013). The Importance of Visualisation in Education. *E-learning & Lifelong Learning*. 1, pp. 453–464.

19. Ward, M. (1997). Overview of Data Visualization. *Computer Science*. Worcester Polytechnic Institute. Retrieved from: https://web.cs.wpi.edu/~matt/courses/cs563/talks/datavis.html.

20. Warwick, L. (2017). Quizlet Efficient, Engaging, Flashcard Tool. *The Digital Teacher*. Cambridge Assessment English. Retrieved from: https://thedigitalteacher.com/reviews/quizlet.