Влияние цифровых сервисов инфографики на эффективность мнемотехники при обучении иноязычной лексике

Проблема и цель. Современная лингводидактика уделяет особое внимание выявлению роли лексики в изучении иностранного языка, определению стратегий изучения иноязычной лексики, поиску методов тестирования словарного запаса, освоения словаря научного дискурса, применению мнемотехник в запоминании лексических норм. Новые форматы обучения обуславливают необходимость применения при изучении иностранного языка технологий визуализации информации и цифровых средств.

Цель исследования – выявить и подтвердить эффективность применения цифровых сервисов инфографики в мнемотехнике для повышения качества обучения иноязычной лексике.


Результаты. Студенты изучают цифровые сервисы инфографики, применяют их для обработки нового лексического материала, запоминания и представления понятий / терминов, устойчивых выражений и комбинирования знакомых лексических элементов в разнообразных контекстах. Выполнена статистическая оценка достоверности положительной динамики в педагогической системе для умений обучающихся узнавать слова, понимать лексические единицы, конструировать новые словосочетания T_{пр} < T_{крит05} (45 < 107).

В заключении обобщаются правила и условия, выполнение которых обеспечивает эффективность применения цифровых сервисов инфографики в мнемотехнике для повышения качества обучения иностранному языку.

Ключевые слова: мнемические операции и приёмы, иностранный язык, визуализация, лингводидактика, запоминание информации, ресурс WordArt

Influence of digital services of infographics on effectiveness of mnemonics when teaching foreign language vocabulary

The problem and the aim. Modern linguodidactics pays special attention to identifying the role of vocabulary in learning a foreign language, determining strategies for learning foreign language vocabulary, finding methods for testing vocabulary, mastering the vocabulary of scientific discourse, using mnemonics in memorizing lexical norms. New training formats necessitate the use of information visualization technologies and digital means in the study of a foreign language.

The purpose of the study is to identify and confirm effectiveness of using digital services of infographics in mnemonics to improve the quality of teaching foreign language vocabulary.

Research methods. Digital tools for data visualization are used in the system of mnemonic operations (grouping, classification, structuring, systematization, analogy, association, repetition) and methods (rhyme, association, mnemonics, chain method, memory cards, mnemonic cards). Infographic services support semantisation of lexical material and its activation, explanation of rules, situational illustration, and foreign language communication. A special test is developed, it includes questions on English vocabulary and assignments based on the methodology of A.R. Luria. Auxiliary visualization methods are used: data design in the form of mind maps, tables, charts, graphs. The experiment involved 30 students of the training program Pedagogical education (Bachelor’s programme) of Vyatka State University. WordArt is used as a digital service of infographics. Statistical processing of the results is performed using the nonparametric method - Wilcoxon’s T-test.

Results. Students learn digital infographic services, use them to study new lexical material, memorize and present concepts/terms, set expressions, and combine familiar lexical elements in a variety of contexts. Statistical assessment of the reliability of positive dynamics of students' skills to recognize words, understand lexical units, to construct new phrases was carried out $T_{\text{emp}} < T_{\text{crit0.05}}$ (45<107).

In conclusion rules and conditions, implementation of which ensures effectiveness of using digital services of infographics in mnemonics to improve quality of teaching a foreign language, are summarized.

Keywords: mnemonic operations and techniques, foreign language, visualization, linguodidactics, memorization of information, WordArt

For Reference:
One of the initiatives of UNESCO, regulated by the 2003 Convention, is the program dedicated to the preservation and development of the language [1]. The two main components of any language are grammar and vocabulary. Special attention is paid to studying vocabulary in modern international linguodidactics. In the comprehensive analysis of scientific and methodological works on teaching vocabulary F. Boers generalizes that researchers identify the following topical areas: role of vocabulary when studying a foreign language, strategies for learning vocabulary of a foreign language, methods of testing vocabulary of foreign language learners, mastering the vocabulary of scientific discourse, using mnemonics when studying vocabulary, using innovative technologies in teaching [2]. For example, R. Karimian Shirejini, A. H. Derakhshan note that there is a contradiction between the number of words of the target language that a student can master in a limited time of study and those communicative tasks that he/she must solve [3]. In addition, most students are faced with the problem of memorizing and reproducing foreign words. A way out of this situation can be the use of innovative pedagogical technologies and various methods of memorizing, storing and reproducing information. One of the methods of enhancing the cognitive activity of students in the opinion of I. J. Chen is mnemonics [4].

Thus, on the one hand, when studying foreign languages various intensive methods are used that activate students' thinking processes. Many language schools and online courses offer their own mnemonic techniques: the use of musical devices, storytelling, etc.

At the same time, the COVID-19 pandemic has had a significant impact on the traditional teaching methodology of academic disciplines in university and school subjects. Since there is a transition of learning to the online space, the degree of assimilation and memorization of the material changes. For example, due to the lack of experience in learning in the network environment using computer platforms and programs. L. Tarkhova et al. come to the conclusion that the efficiency of assimilation of theoretical facts and concepts can be increased by introducing new technologies into linguodidactics that can be used not only in the online space, but also in the classroom [5].

Infographic resources can be used when implementing such innovative technologies. Infographics are a visual presentation of a variety of textual and statistical information. According to A. V. Makulin, integration of visual aids into the process of teaching languages is a promising direction [6]. Such tools not only meet modern requirements of language teaching, but are also multifaceted in relation to types of tasks where they can be used (project activities, organization of research activities).

In conditions of development of the digital educational space in the arsenal of modern teachers interactive services appear, they support collecting information, comprehension, highlighting the important and the secondary, processing and transferring it from one type to another. Such educational and cognitive activities also fully comply with the requirements of the current federal educational standards.

At the moment there are some studies on the inclusion of digital services of infographics in teaching students of pedagogical training programs (for example, when preparing future physics teachers [7]). However, teaching foreign language vocabulary has its own fundamental methodological principles, techniques and methods of memorizing new words, techniques for formation of lexical skills, a system of exercises [8]. Thus, there is an
objective need for additional study of the issues of including digital services of infographics in teaching foreign language vocabulary as an innovative pedagogical technology of higher education in order to:

1. include new methods and means of storing information in formation of foreign language competence in general and lexical competence in particular;
2. use digital services of infographics in educational, cognitive, professional, communicative activities of future highly qualified specialists.

The research hypothesis - the use of digital tools for visual presentation of information, memorization and presentation of concepts/terms when teaching a foreign language will provide additional conditions in situations of:

- introduction, semantization of a new word and its primary repeating;
- training and creating strong speech connections;
- creating dynamic lexical speech connections, that is learning how to combine familiar lexical elements in a variety of contexts.

The purpose of the study is to identify and confirm effectiveness of using digital services of infographics in mnemonics to improve the quality of teaching foreign language vocabulary.

Materials and methods

The following methods were used in the work: theoretical analysis and generalization of literature when describing conditions for effective teaching of foreign language vocabulary, techniques of mnemonics in linguodidactics, and the didactic potential of digital means of visual presentation of information.

The work used modern mnemonic operations (grouping, classification, structuring, systematization, schematization, analogy, recoding, association, repetition) and methods (rhyme, association, chain method, memory cards, mind maps).

The main element of infographics as a technology of cognitive visualization is the shift in emphasis from the illustrative function in teaching to development of cognitive abilities, critical thinking of students.

Infographics are used as a means for the semantisation of lexical material and its activation, explanation of rules, situational illustration, and foreign language communication. The study used static (graphic images, mind maps) and dynamic (graphic images with added animation and possibility to transform) infographics.

Creating infographics by students is carried out taking into account principles of the system-activity approach to learning: understanding of relationships, principles and algorithms of word formation happens when compiling a set of words; attention and memory are activated.

When organizing practical work with digital infographic services, WordArt was used (https://wordart.com/). This resource is for creating tag (word) clouds. It is helpful for users with no prior knowledge of graphic design. WordArt includes tools for visualizing concepts you need to focus on.

To obtain up-to-date information on effectiveness of using digital services of infographics in mnemonics when teaching foreign language vocabulary empirical methods are used: monitoring communication of all participants of interaction; analysis of answers, results of working with the digital infographic service (the number of words in the cloud and the connections between them); the number of attempts to build a word cloud; time to study
theoretical material; the volume and correspondence of functional capabilities used for cognitive visualization, etc.

To assess the input conditions testing was used, which includes 20 tasks on the topics of the discipline "Foreign language" and a task based on the methodology of A. R. Luria. The time to do the tasks is 100 minutes, since the chosen technique includes delayed (in 50-60 minutes) repeating. Also, auxiliary methods of computer data processing were used: data design in the form of mind maps, tables, diagrams, graphs.

The experimental study was carried out on the basis of Vyatka State University while studying the courses “Digital Technologies in Education” and “Foreign Language”. 30 first year students of the training program Pedagogical education (Bachelor’s programme) were involved. The software is the WordArt (https://wordart.com/). The average age of the respondents was 19 (78% of girls and 12% of young men). Classes in both disciplines were conducted by the same teacher. The choice of only one group was justified by the following circumstance: the work program for the chosen training program was changed. As a consequence, it was not possible to maintain the same conditions for data comparison. Since there was a comparison of two dependent samples, statistical processing of the results was performed using a nonparametric method – Wilcoxon’s T-test.

Literature review

Analyzing various approaches that foreign specialists in linguodidactics use in the practice of teaching English, F. Boers notes that the modern methodology considers vocabulary as one of the integral components of formation and development of speech skills [2]. Vocabulary in the works of D. Özmat and N. Senemoğlu is understood as a set of words that are part of the language [9]. R. Karimian Shirejini and A. Derakhshan define that knowledge of foreign languages has recently become an integral part of the professional competence of many specialists [3].

D. J. Nishonova et al. understand lexical competence as knowledge of vocabulary of a language, which includes elements of vocabulary and grammar and the ability to use them in speech [10]. Thus, according to the provisions of the work of T. Miyatsu and M. A. McDaniel, mastering vocabulary allows: to create necessary conditions for communication in a foreign language; correctly, clearly formulate thoughts; develop cognitive abilities; develop a linguistic personality as a culture-bearer [11]. The authors conclude that when studying a foreign language, all linguistic material can be divided into 3 large groups: words, grammar and fixed expressions.

O. M. Osiyanova and V. D. Demina conclude that the process of memorizing new words is the most laborious. At the word level the pronunciation of English words is mastered; the ability to perceive words by ear, the ability to read, and then the ability to write in English are practiced [12].

G. A. Shor, N. E. Korn believe that the introduction of new training components is not only a clarification of the content of training, but also the search and development of adequate teaching aids, which are a prerequisite for effectiveness of the process of teaching a foreign language [13]. Although didactic means do not have a decisive influence on results of educational work, they nevertheless facilitate the acquisition of knowledge. They just have to be correctly selected; skillfully incorporated into the methods and organizational
forms of teaching used by the teacher. This can enrich the use of teaching methods and increase their effectiveness.

In international practice various intensive methods are used when studying foreign languages. For example, J. Chen describes learning outcomes, where memorization of new words occurs through songs and music videos without subtitles [4]. A comprehensive study by F. Ciaramella, E. A. Lorè, A. Rega is also devoted to the search for new methods and techniques for memorizing foreign language vocabulary [14]. When analyzing the literature, the authors conclude that many language schools and online courses offer their own techniques for using mnemonics. In schools and universities teachers rely on the accumulated theoretical material and practical teaching experience and develop and use their own methods.

Based on experimental data T. Miyatsu, M. A. McDaniel argue that techniques of mnemonics are quite effective, they should be used for memorizing foreign language vocabulary [11]. Mnemonics, in their opinion, is a system of various techniques and methods that make it easier to memorize a large amount of information, most often it happens by creating associations and images. Domestic specialists in didactics, whose authority is recognized in the world community, A. V. Makulin, M. I. Korzat conclude: the traditional process of memorizing five unknown words by a modern schoolchild is associated with torment, with graphics it becomes fascinating [6].

So, according to E. E. Naumenko et al. mnemonics is a promising direction in teaching, which allows not only to learn foreign languages, but also to activate reserves of memory and thinking [15]. Its essence lies in the fact that it is usually difficult to memorize disparate, unrelated facts and phenomena. When there is a connection between new information and existing information, memorization, which is proved in the work of O. Yu. Muller, is much easier and faster. In many respects it happens thanks to the logical associative connections between objects and images [16].

The result of training in a modern university should be formation of the bilingual linguistic personality capable of using own language and speech competences in order to be competitive in the labor market [17]. F. M. Hamid et al. prove that the active inclusion of working with various types of infographics in the curriculum will make development of communicative norms of a language more effective [18]. They study various effects of such classroom work. Infographic tools allow students to focus on the correct use of endings in various grammatical forms. In addition, the effect of visualization should be considered. From the cognitive point of view in the basis of work with infographics cognitive mechanisms of perception and processing of information, activation of associative (subject-logical) connections are involved; the connections arise during the work of images that require verbalization [19].

In addition, “at the level of verbal-logical reflection-display of information (written speech) the visual series also plays an important role in development and support of the person’s speech and thinking abilities”. According to D. Roy, if habitual visualization is a representation of a phenomenon or process in a form convenient for visual perception, then cognitive visualization is a more multifaceted concept [20]. Cognitive visualization also refers to a certain illustration of the studied subject, but at the same time it involves its subsequent rethinking.

Infographics is an alternative way of presenting information, combining illustrations and verbal and logical content of the text. The use of educational technologies based on infographics increases effectiveness of language teaching, which is expressed in a qualitative increase in the level of foreign communicative competence [7].
S. Simakova believes that infographics is a cognitive visualization tool; it is characterized as a graphical way of presenting certain information. The main goal is to present complex information clearly and quickly [21]. A. V. Makulin, M. I. Basket note that infographics as a methodological device allows to combine visual elements and the logical content of text fragments that explain them [6]. Infographics can be used in general to practice communication skills in the digital space; for critical analysis of certain information; for development of visual thinking [22]. All of the listed characteristic features of infographics correspond to modern tasks of teaching a foreign language [23].

D. Roy notes possibilities of multimedia technologies for implementation of infographics in teaching a foreign language. Typology of infographics can be different: from the position of the presentation object (statistical infographics, timeline, map, diagram, hierarchy, matrix, algorithm, photo, comparison); from the standpoint of technology static, dynamic, video-infographics are distinguished [20].

On the one hand, mnemonics as a set of techniques that increase the amount of memory and make it easier to memorize information is an effective technology in teaching foreign language vocabulary. On the other hand, infographics includes a wide range of functionalities for creating associations and images. In addition, there is an active development of computer technologies for presentation of infographics in the digital space.

Thus, there is an objective need for additional study of the issues of including computer services of infographics in teaching foreign language vocabulary as an innovative pedagogical technology of the digital school.

Research program

The main goal of the experiment was to assess the impact of digital infographic services on effectiveness of mnemonics in teaching foreign language vocabulary. The experimental study was carried out on the basis of Vyatka State University while studying the courses “Digital Technologies in Education” and “Foreign Language”. 30 first year students of the training program Pedagogical education (Bachelor’s programme) were involved. The software is the WordArt (https://wordart.com/). The average age of the respondents was 19 (78% of girls and 12% of young men). Classes in both disciplines were conducted by the same teacher.

At the preparatory stage of the experiment the teacher considered various techniques of mnemonics, which are actively used in teaching foreign language vocabulary. The following mnemonic operations were analyzed and selected: grouping, classification, structuring, systematization, schematization, analogy, recoding, association, repetition. It was decided to use the following methods to support cognitive visualization: rhyme, association, chain method, memory cards, mind maps. For example, the chain method and analogy were used when memorizing national holidays, cities. Flash cards were used in the study of modern professions.

Various digital services to support infographics were analyzed: http://www.visual.ly, www.dailyinfographic.com, www.coolinfographics.com, https://wordart.com/, https://www.canva.com/ru_ru/, https://www.gloster.com/ and others. The following criteria were used as selection criteria: type of technology (cloud/online or offline), financial basis (free/commercial), functionality (adding illustrations/graphic images, work with animation, audio import (music/sound), interface and design. Based on the analytical work the WordArt
service (https://wordart.com/) was chosen. Its advantages over the others are: it is easy to use, it allows load word lists, fonts and surfaces, it has various forms of export and it is free. There are only two exceptions: 1) if you want to use word clouds obtained using the service for commercial purposes; 2) free download of clouds in high quality is not available (these are images that the average user will never need).

Testing was developed to assess the input conditions; it includes 20 tasks on the topics of the discipline "Foreign language" and a task based on the methodology of A. R. Luria. The time to do the tasks is 100 minutes, since the chosen technique includes delayed (in 50-60 minutes) repeating. The materials of the fund of assessment tools are compiled according to the working program, take into account the theoretical and practical nature of activities when teaching foreign language vocabulary. Examples of tasks:

1 (to test the ability to critically evaluate information, the ability to find errors in the use of word formation methods). Students are invited to listen/read word forms and express their opinion (Can you say so? How to say it correctly?). For example, butter is in the "butter course" (butter dish); salt is in the "salt keeper" (salt shaker).

2 “Palindromes”. Students write down words (on a specific topic or from the available vocabulary) backwards. Modification of the task: Students decipher the word. If this is a noun, then the article is also called.

3 (association / analogy / grouping). The teacher invites students to fill in a table of three columns (teachers, world scientists) using personalities from the list (Ushinsky, Makarenko, Tsialkovsky, Newton, Sean Young, Tolstoy, Amonashvili, Owen, Shakespeare).

Modification of the task: by analogy with the game "Cities". Continue the list: Makarenko, Owen, Newton, etc.

4 (knowledge). "In what year did the UN start holding International Women's Day?" or "What day do unmarried girls make wild guesses?"

For each completed task the student received 1 point.

It was necessary to choose the appropriate method for diagnosis since the use of mnemonics involves activation of memory and attention. The following methods were analyzed: “Memorizing 10 words” (A. R. Luria), “Mediated memorization” (A. N. Leontyev), “Pictogram” (L. S. Vygotsky, A. R. Luria, S. V. Loginova), "Reproduction of stories" and express methods ("Cross out the named pictures", "Numbers and letters" and others). The methodology of A. R. Luria “Memorizing 10 words” was selected and adapted for the study, since it is used in a complex manner. It was used to assess the state of memory, fatigue and attention activity. The teacher prepared a protocol with nine short monosyllabic and two-syllable words that had no connection with each other. They were nouns in the singular nominative case, not related to each other. For example, at the preparatory stage the study used the option “Number, chorus, stone, mushroom, cinema, umbrella, sea, bumblebee, lamp, lynx”. The words were repeated 5 times. Normally, after the first presentation the student must reproduce from three to five words, after the fifth – from eight to ten. After delayed repeating it is seven to nine words.

Based on the results of the work the student scores points according to the algorithm:

- 4 points (remembered 9-10 words after the fifth presentation, 8-9 words after delayed repeating);
- 3 points (remembered 6–8 words after the fifth presentation, 5–7 words after delayed repeating);
- 2 points (remembered 3-5 words after the fifth presentation, 3-4 words after delayed repeating);
1 point (remembered 0–2 words after the fifth presentation, 0–2 after delayed repeating).

Thus, students could receive from 1 to 24 points for the control testing. Thus, it was possible to collect data on 30 students.

The second stage of the experiment was devoted to changing the structure of the sections for studying vocabulary of a foreign language in accordance with the purpose of the study. Firstly the teacher in the classroom during “Digital Technologies in Education” class studied the digital service to support infographics. Then, in foreign language classes the topics “Traveling”, “Food”, “Education” were mastered.

The third stage of the study. Further, when organizing practical work, the research and creative activity students were offered the studied concepts, new words and stable expressions to organize in the form of a cloud of words. The student could use WordArt as a computer program. But the student was free to choose and use a different digital service.

Research results

In the process of analysis and generalization of scientific literature the authors' positions on the key concepts of the study were determined:

- mnemonics is a system of methods and techniques that ensure effective memorization, storing and reproduction of information, and support development of speech;
- infographics is one of the ways to form students' written competence. Infographics is a fusion of the use of information and communication technologies and information visualization. This is not just any graph or diagram built on the basis of a certain amount of data, but a metaphorical formation of visual information;
- main functions of infographics: informative, analytical, constructive, adaptive, expressive, aesthetic;
- connection between mnemonics and infographics is that the latter supports a combined effect on the organs of sight and hearing. This happens with the help of audiovisual, multimedia tools that affect long-term memory and ensure the processing and assimilation of information;
- digital infographic services are applications that due to built-in tools and templates allow to automate processing and structuring of statistical information (presented in the form of a graph, table, animation).

One group is involved in the experimental study, therefore, before studying digital infographic services, including them in mnemonics when teaching foreign language vocabulary, an entry test was carried out. Students were asked to answer 20 questions and complete tasks according to the method of A. R. Luria. The measurement results are presented in Table 1

1. To find out what visualization, infographics are using methodological material (for example, https://prezi.com/view/GfdKBtmkOsyTpsabuu2F/).
2. To learn to use the WordArt service when solving educational and cognitive tasks.

The actual result is a report on the work done, a text document WordArt_<Group_Surname>.docx ". Tasks marked with * required any real answers (screenshot, explanation, solution) to be included in the report. Tasks not marked with * are compulsory to do, but they did not require additional data to be entered into the report. The research activities of students were carried out according to the specific plan.
1. Sign up for WordArt.
2. Explore the interface and functionality of WordArt.
3. *Create a word cloud using the example provided by the teacher in the WordArt service.

Homework 4. * Create your own word cloud that reflects the specifics of your subject.
5. *Write a review (8-10 sentences) about using WordArt. Record the merits and demerits of WordArt that you noted. Write whether you would use WordArt in your teaching activities or not.

Every word cloud, WordArt project has a name. Word cloud management contains the following groups: Words, Shapes, Fonts, Display, Colors, Export. It is possible to add words one at a time (to enter into the window or to manually add a new line using the button). Alternatively, a list of words can be imported at once. For each word, the size, Color, Angle, Font, Link can be specified. In the course of work students used the following tools: rename the project, save the project as, print the word cloud, delete the project; change the terms of privacy, links to methodological developments for creating word clouds in English, to pictograms.

Specific practical results that marked the end of practical activities in the infographic service:
1. Theoretical knowledge about visualization tools in modern education.
2. Formation of the ability to create interactive word clouds using the WordArt.
3. Understanding the practical value of the products of this service.

An interactive word cloud that reflects the specifics of the subject. Figure 1 shows one of the results of the students' work in WordArt.

Further the students were asked to do a creative task (project) on using digital infographics service when studying a foreign language. For example, students modeled the infographics “Algorithm of registration on the site”. Working with it involved the following subtasks:

a. Write down the algorithm using present tense verbs in the third person plural.
b. Change the mood of the verbs in the text. Use verbs in the imperative ("do"), indicate forms of verbs.
c. Write out all material nouns from the infographics.
d. Write out all cardinal numbers from the infographics.
e. Using the infographics, fill in gaps in the text using cardinal numbers.
f. Create text based on the infographics.
Further in a foreign language classroom, when studying the topics “Traveling”, “Food”, “Education” students did tasks that integrate infographics into the techniques of mnemonics.

Example 1. Mnemonics in English make it easy to remember the quantity of days in months: Thirty days has September, April, June and November. In February, as you know, there are 28 or 29 days, and in the rest of the months there are 31 days. Develop a "word cloud" for visualizing the mnemonics (own or from the Internet).

Example 2. Using a chain of associative images you can remember the PIN code of your bank card. Let's say you need to remember the number “1850”. Then it is necessary to assign a bright image to each number in a certain sequence. The number “1” looks like a crane. The number "8" looks like the symbol of infinity or cloud. The number “5” can be associated with a five-storeyed building or the mark “5” (excellent, first-class). The number “0” is like a circle, like a round window. Then you can imagine and remember the following picture: a crane raises its boom into endless clouds and builds a five-storeyed first-class house with round windows. Develop an infographics for computer visualization of this image.

Example 3. The teacher selects a set of static images, rules on the topic "How to defeat a jet lag". Students need to design dynamic infographics to automatically resize it based on location and travel goals. Next the reverse task is. Share the received interactive posters with each other. Translate the text of the infographics into Russian.

At the fixing stage of the experiment the questionnaire according to the method of A. R. Luria and testing based on the course materials were again conducted. The post-experiment data are also presented in Table 1.

### Table 1

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Analyzing the data in the table we notice that only three respondents from the group have a “negative” trend (“-1”, “-4”, “-8”). 26 students undergo positive qualitative changes: from 1 to 20 points.

Next, it is necessary to show the statistical significance of the obtained result. The number of points the student receives for testing is a measurable criterion. By the value of this criterion the level of the student's lexical competence can be judged. This criterion as well as the difference between the values obtained in the second and first tests (the so-called shifts) have the following properties: connectivity (if \( a \neq b \), then either \( a < b \) or \( a > b \)), asymmetry (if \( a < b \), then \( a \neq b \)), transitivity (if \( a < b \) and \( b < c \), then \( a < c \)). This is a sign that this criterion sets a scale of order for measuring the studied quality (the ability to perform tasks on foreign language vocabulary). In such a situation, taking into account that the samples are dependent, it is possible to prove the statistical significance of the differences using the Wilcoxon nonparametric T-test. In this case, the hypothesis is formulated as follows:

- \( H_0: \) the observed shifts in the direction of increasing the scores of the test results can be explained by the influence of purely random factors and are not statistically significant.
- \( H_1: \) The observed shifts in the test results are not accidental and are statistically significant.

For a shift in an atypical direction a negative value is taken (i.e., a shift towards a decrease in the number of tasks solved in the test) because most of the shifts are in the positive direction. Zero shift is dropped. So, \( N = 27 \).

The value of the Wilcoxon T-test is equal to the sum of the shift ranks in the atypical direction: \( T_{\text{emp}} = \sum (R_i) = 45 \). According to the tables (https://medstatistic.ru/methods/methods3.html), the critical values for \( N = 27 \) of this criterion are as follows: \( T_{\text{crit}}(p = 0.05) = 107, T_{\text{crit}}(p = 0.01) = 83 \). We get that \( T_{\text{emp}} < T_{\text{crit}(0.05)} (45 < 107) \). So, hypothesis \( H_0 \) is rejected and the observed typical shifts are not accidental. The recorded shifts are due to the use of digital services of infographics in mnemonics when teaching foreign language vocabulary.

### Discussion of the results

In the course of the pedagogical experiment it was possible to find out that the typical shifts that occurred can only be due to factors influencing the student in the period between the first and second testing. It is most likely that the ability of students to do tasks, exercises on foreign language vocabulary was influenced by working with the digital service of infographics as a means of mnemonics. Indeed, the tasks on the topics were carried out only according to the described system. There were no other pedagogical influences.
on students when studying foreign language vocabulary. Therefore, the positive dynamics recorded in terms of the ability of students to recognize words, understand lexical units, carry out transformation at the level of words/phrases, construct and combine new phrases can be only due to the use of digital infographic services in mnemonics.

Of the other functional capabilities that have a positive didactic effect on cognitive interest, memory, attention, the participants in the experiment noted:
- using accounts of worldwide social networks (Facebook, G+ or Twitter);
- ability to repeat words, the presence of hyperlinks;
- creating own form for word clouds.

Also in the discussion the following advantages of using infographic elements when teaching a foreign language were highlighted: work with a large amount of theoretical information; rich lexical material, active vocabulary; solving a variety of tasks (transformation of both content and form); development of information literacy; training to critically think of network sources, etc.

The latter advantage is of particular importance in the context of training highly qualified specialists of the future. Working with infographics only at the first stage is a reflection (What is it? What is this image associated with? What famous/unknown words are used?, etc.). Further, the work process is based on identifying information hidden in the infographics about the hierarchy, importance/relevance, cause-and-effect relationships in foreign language vocabulary. On the basis of observations carried out after the experimental teaching a decrease in the number of spelling mistakes in English words, a quick mastering abstract concepts, improvement in memory and attention indicators in students were noted.

As directions for improving the proposed option for using digital means for visual presentation of information, memorizing and presenting concepts/terms when teaching a foreign language the following were proposed: to expand the range of infographics with clouds of foreign words to other disciplines (for example, “Pedagogy”, “Age anatomy, physiology and hygiene”); to add tasks to establish a connection between vocabulary and grammar (for example, when studying the topic “Education” to talk about past school habit using ‘used to’).

The positive influence of infographics on the teaching of grammar was proven in foreign works [24]. However, the research materials justify that this is also true for another subsystem of the language - vocabulary. The research materials confirm the conclusions of F. Boers about the potential of mnemonics for teaching foreign language vocabulary [1] and expand the ideas of O. Kalugina, N. Tarasevich about the potential of digital services for training highly qualified specialists of the future [7].

The obtained results develop and complement the conclusions of Yu. Radchenko to the level of innovative pedagogical technologies and digital means [25]. Moreover, they fully correspond to the data of V. Pisarenko, M. Bondarev that visual technology activates cognition, stimulates intellectual activity [26].

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**Conclusion**

The most important principle of modern education is optimization of learning through the use of innovative educational psychological and pedagogical technologies. One of them is mnemonics as a system of effective methods for supporting assimilation of large volumes of theoretical material by students and preventing information overload.
For foreign language teachers the use of mnemonic operations, techniques is of particular importance when learning new words (memorization); converting words into images (encoding); formation of connections between support images and memorized images (memorization); exclusion of intermediate images through formation of a direct connection word/pronunciation – image/meaning of the word (consolidation of connections in the brain).

In the course of analytical activities it was found that the use of infographics in teaching a foreign language contributes to: increasing the degree of assimilation of information due to visual images with the help of which this information is presented; lowering the level of information noise in the process of foreign language communication; successful conceptualization of the topic on which the information is presented.

The research materials allow us to reasonably assert that the use of digital tools for visual presentation of information, memorization and presentation of concepts/terms when teaching a foreign language will provide additional conditions for introduction, semantization of a new word and its primary reproduction; training and creating strong speech connections; creating dynamic lexical speech connections.

When summarizing the results of the pedagogical experiment the rules, implementation of which ensures effectiveness of using digital services of infographics in mnemonics to improve the quality of teaching foreign language vocabulary, were formulated:

- creating an information resource in the program environment should be preceded by work on the analysis of the corresponding mnemonics (for example, to consider various mnemonics on the New Year, highlight key words in them, analyze lexical norms);
- behind each word in the interactive "word cloud" (interactive poster) there should be a hyperlink to a specific theoretical material;
- infographics must have at least 15 words;
- the shape of the cloud should reflect the topic of vocabulary.
- when you hover over a word, the word should change color/style, but not the relationship with other words (lexical norms);
- displaying words in the cloud should not only be horizontal;
- organization of oral discussion of digital resources, ensuring the relationship of visual and speech material with the specific language situation.

If there is enough time, a class discussion on the topic of infographics can be organized. For example, discussion of students’ personal experience, their advice can be used while traveling or when choosing a profession. Mnemonic exercises, supported by digital resources, contribute to development of reading and translation skills as well as the ability to debate on the specific topic and speak out loud. Besides, infographics can be used as a form of control.

Dynamic images in infographics have a positive effect on formation of the skill of language guessing, a significant component of compensatory competence and activating the chain of mental operations. This fits the essence of infographics as a cognitive visualization tool.

Thus, the inclusion of digital services of infographics in mnemonics and for visual presentation of information is an effective method of teaching foreign language vocabulary.

The proposed technique can be applied variably for organizing the learning process and perceiving information in the online space and in other disciplines, since it uses the universal properties of memory.
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