Mental maps as an innovative tool in university training

Ментальні карти як інноваційний інструмент університетської підготовки

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Abstract

The article reveals the content and considers the mental map from the perspective of innovative training of specialists in the modern educational environment of higher education. Different positions of considering the mental map as an innovative tool in training specialists are shown. Cloud services are presented that can be used in developing mental maps when preparing seminar or lecture classes, and types of mental maps in the modern educational environment of higher education are identified. The rules for creating them are developed, and the advantages of a mental map as an innovative tool in training specialists in the modern educational environment of higher education are shown. Comparison of quantitative and qualitative analyses of the results of the experiment indicates that the implementation of pedagogical conditions in the process of introducing a special course in EG according to the components of the diagnostic

Анотація

У статті розкрито зміст та здійснено розгляд ментальної карти з позиції інноваційної підготовці фахівців у сучасному освітньому середовищі вищої школи. Показано різні позиції розгляду ментальної карти як інноваційного інструменту при підготовці фахівців. Представлено хмарні сервіси, які можна використовувати у процесі розробки ментальних карт при підготовці семінарських чи лекційних занять та виокремлено типи ментальних карт у сучасному освітньому середовищі вищої школи. Розроблено правила створення та показано переваги ментальної карти як інноваційного інструменту при підготовці фахівців у сучасному освітньому середовищі вищої школи. Порівняння кількісного й якісного аналізів результатів експерименту вказує на те, що реалізація впровадження педагогічних умов в процесі введення спецкурсу в ЕГ за компонентами

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apparatus led to statistically significant changes, an increase in scores on the motivational criterion, cognitive criterion, activity criterion, and evaluation criterion, and therefore we observe positive dynamics in the use of mental maps by higher education applicants and their positive impact on the process of training specialists in the modern educational environment of higher education.

Keywords: training of specialists, higher education, cloud services, mental map, innovations in education.

діагностичного апарату привела до статистично важливих змін, збільшення оцінок за мотиваційним критерієм, когнітивним критерієм, діяльнісним критерієм і оцінювальним критерієм, а відтак спостерігаємо позитивну динаміку використання ментальних карт здобувачами вищої освіти та їх позитивний вплив на процес підготовки фахівців у сучасному освітньому середовищі вищої школи.

Ключові слова: підготовка фахівців, вища школа, хмарні сервіси. ментальна карта, інновації в освіті.

Introduction

The problem of training new generation teachers is caused by a set of factors, including the renewal of the content of education; a significant expansion of the professional functions of the teacher as a subject of innovative activity; the need to constantly search for new innovative forms, methods of teaching and upbringing, taking into account the realities and needs of practice; the ability to build conceptual foundations of pedagogical innovations; the need to involve students in search activities and experimentation, occupy leading positions. Under such conditions, there is a need to rethink the priority areas of development of higher pedagogical education, one of which is the modeling of an effective system of professional training of a competent teacher focused on innovative activity (Stupak, 2022).

Modern conditions for training higher education specialists stimulate and increase the interest of scientific and pedagogical workers in the use of interactive teaching aids, information visualization, and high-quality presentation of theoretical material, as well as the organization of students' educational and search activities. Among the innovative technologies used in the training of specialists, we can name: online boards, quizzes, web quests, and mental maps.

Various platforms and resources used during distance learning should complement each other and perform certain functions in the educational process. At the same time, working with mind maps remains a universal and generalizing technology, and expanding the possibilities for using online resources to create them is seen as a relevant and relevant issue (Lavrenova, 2019).

95.7% of teachers know what a "mind map" is, and more than 58.7% of teachers use mind maps in their work. 65.6% of teachers believe that it is appropriate to use mind maps in their work, and 34.4% believe that it is not. Such results indicate that teachers follow the innovative trends of modern primary education, and understand the current directions of its development.

At the same time, a theoretical analysis of the problem showed that the issue of mind maps as an innovative tool for university training has not been the subject of separate research in both theoretical and practical aspects.

The use of mental maps in the quality training of future specialists is currently a relevant issue of the theory and methodology of learning in the educational process. Based on this, we considered the following questions in the article:

− The content and consideration of the mental map from the perspective of innovative training of specialists in the modern educational environment of higher education.
− Different positions of considering the mental map as an innovative tool in the training of specialists.
− Cloud services can be used in the process of developing mental maps when preparing seminars or lectures.
− Types of mental maps in the modern educational environment of higher education.
− Using online resources to create interactive online mental maps.
− Rules for creating and advantages of a mental map as an innovative tool in the training of specialists in the modern educational environment of higher education.

Literature Review

The topic of using mental maps is being studied by modern scientists in connection with learning and the generation of new ideas. In the first case, visually structured data contributes to easier memorization, and in the second – the ability to understand the structural units of the problem for further analysis. The effectiveness of mental maps for the memorization process is being studied by most scientists. Currently, several researchers M. Lavrenova (2019), I. Sydoruk (2020), and O. Stupak (2022) analyzed the educational process of higher education regarding the experience of using mental maps and their use in the work of specialists.

The involvement of the mental map technique in the training of specialists in the modern educational environment of higher education is justified and is studied by scientists from various disciplines. Thus, V. Shcherbatiuk (2020) draws attention to the features of the visualization tool, the use and production of mental maps in higher education institutions during the teaching of literary disciplines. He proves that the mental map method is an effective tool that ensures the preservation of information in the student's memory and structuring for subsequent effective retrieval. He introduces the concept of clip thinking to the study of literary disciplines as a way to increase the efficiency of the learning process, as an acquired quality of the modern generation.

At the same time, mental maps in scientific research are defined as an innovative way of organizing information in the educational process of higher education institutions, which makes it possible to actualize the work of the right (figurative) and left (logical) hemispheres of the brain simultaneously through a radial presentation of the content of education. The use of mental maps allows for mutually complementary activities of the teacher and students, resulting in the most complete awareness of a specific topic by the subjects of educational activity.

L. Panina (2020) outlines the effectiveness of using mental maps as one of the ways to develop students' critical thinking in the process of studying the Ukrainian language and literature, improving the quality of knowledge of students in secondary education institutions. The researcher analyzed the methods of using mental maps, analyzed the main functional characteristics of mental maps, and characterized the features of their creation and structure. O. Hyria (2022) shows the possibilities of using mental maps to form integrated knowledge of students in chemistry lessons, to apply them in extracurricular work, in the process of creating group and individual projects to help systematize and organize scientific information, thoughts, assess the volume and planning of work, group scientific data, initiate new ideas, and summarize scientific achievements in a certain field of research. The developed mental maps for the school course of human biology by T. Pozdniakova (2018) were tested. The relevance of using mental maps in the professional activity of a teacher is substantiated; the stages of creation and the basic principles of mental maps are considered; various ways of using mental maps in the educational process are proposed.

According to the results of the analysis of scientific and methodological literature, it was found that a small number of works are devoted to the development and implementation of mental maps in the educational process of higher education institutions, which contribute to the formation of theoretical knowledge and practical preparedness, which requires further scientific research, emphasizing the relevance and practical component of the chosen direction of research.

The relevance of the problem is enhanced by the need to eliminate contradictions in the research process between:

- Society's need for highly qualified specialists and the presence of stereotypes regarding prioritizing professional specialties;
- The need to improve the quality of student learning and the insufficient use of mental maps to implement didactic goals in the educational process of higher education institutions;
- The potential pedagogical capabilities of ICT and the degree of substantiation and experimental verification of the didactic conditions for the use of mental maps in the process of student learning.

Thus, the relevance of the problem raised, the theoretical and practical benefits of its solution, the lack of development in pedagogical science, as well as the need to eliminate the identified contradictions determined the choice of the topic of the article.

The study's purpose is to prove the mental map's effectiveness as an innovative tool in the training of specialists in the modern educational environment of higher education.

Methodology

To achieve the goal, the following research methods were used: theoretical – analysis of philosophical, pedagogical, methodological literature on the research problem, system analysis to compare different points of view on the problem under study and to determine the conceptual and categorical apparatus of the study, consideration of theoretical issues, justification of pedagogical conditions and the developed special course "The use of mental maps in the professional training of students in the modern educational environment of higher education for high-quality learning"; empirical – diagnostic methods (questionnaires, interviews, surveys), observational methods (observation), experimental (conducting a pedagogical experiment) to determine and verify the level of use of mental maps by higher education applicants and their positive impact on the process of training specialists in the modern educational environment of higher education; methods of mathematical statistics – to analyze the results obtained.

The implementation of the pedagogical experiment was carried out in three stages: preparatory, main, and final.

At the preparatory stage, the goal and objectives of the study were determined, the experimental plan was developed, methods of measurement and processing of results were selected, control and experimental groups were selected, and their homogeneity was checked.

At the main stage, the experiment was conducted.

At the final stage, the results of the experiment were analyzed, their reliability was confirmed, and conclusions were drawn about the pedagogical effect of the experiment.

The experiment was attended by 48 EG students and 46 CG students, which corresponds to the calculation data since the sufficient sample size is 94.

The reliability and validity of the results obtained, and the objectivity of their assessment were ensured by the methodological soundness of the initial positions and the qualimetric mechanism for assessing the quality under study, the use of a complex of complementary research methods, and the involvement of a group of respondents from a higher educational institution in the analysis of its results.

To assess the homogeneity of experimental and control data collection, statistical processing was carried out using MS Excel and SPSS (Statistical Package for Social Science) programs.

In our article, we used quantitative methods of data analysis. This group of empirical research methods includes methods of obtaining information about the object under study that allow identifying its quantitative characteristics.

The experimental work was carried out without violating the structure of classes in the conditions of the current educational process of higher education and the content of the curriculum provided for by the curricula. The main base for the experiment was higher education institutions.

In the ascertaining experiment, the CG and EG of students were determined, and the levels of readiness of future specialists for the development and application of mental maps as an innovative tool in the modern educational environment of higher education were studied. In this case, experimental research methods were used: observation, questionnaires, conversations, and surveys.

The ascertaining stage of the study was conducted in the modern realities of higher education to develop a diagnostic apparatus, identify the state of the problem under study, determine its pedagogical feasibility and relevance, and form students' independent work. First-year undergraduate students participated in the ascertaining stage of the study. At the ascertaining stage, a question was proposed to clarify the feasibility of using and the ability to use mental maps as an innovative tool in the training of specialists in the modern educational environment of higher education. The results obtained indicate that for working with the use of mental maps in professional training in the modern educational environment of higher education for high-

quality education of higher education, students were not prepared, that is, students who had recently entered the university did not have practical skills in working with mental maps, did not know cloud services that can be used in the process of developing mental maps in the preparation of seminar or lecture classes; could not name the types of mental maps in the modern educational environment of higher education, did not know the rules for creating and the advantages of a mental map.

At the formative stage of the experiment, pedagogical conditions were introduced, and a special course "Using mental maps in the professional training of students in the modern educational environment of higher education for high-quality learning" was developed, which was introduced in the EG, and the CG studied according to the usual methodology.

A comparison of the quantitative and qualitative analyses of the experiment results indicates that the implementation of pedagogical conditions in the process of introducing a special course in EG according to the components of the diagnostic apparatus led to statistically significant changes, an increase in scores on motivational, cognitive, activity and evaluation criteria, and therefore we observe positive dynamics in the use of mental maps by higher education applicants and their positive impact on the process of training specialists in the modern educational environment of higher education.

As a result of the experiment, a non-parametric method of testing statistical hypotheses was used to verify the reliability of the conclusions – the Wilcoxon criterion. The processing of experimental data allowed us to verify the application of statistical methods and obtain confirmation of the correctness of the research methodology and the achievement of the set goal.

Results and Discussion

1. **The content and consideration of the mental map from the perspective of innovative training of specialists in the modern educational environment of higher education.**

Mental map, mental map, intellectual map, memory map, mental action map, idea map, thought map – these are different names for the Mental mapping method. The main feature of this method is to clarify the information by mapping, visualization, and presentation.
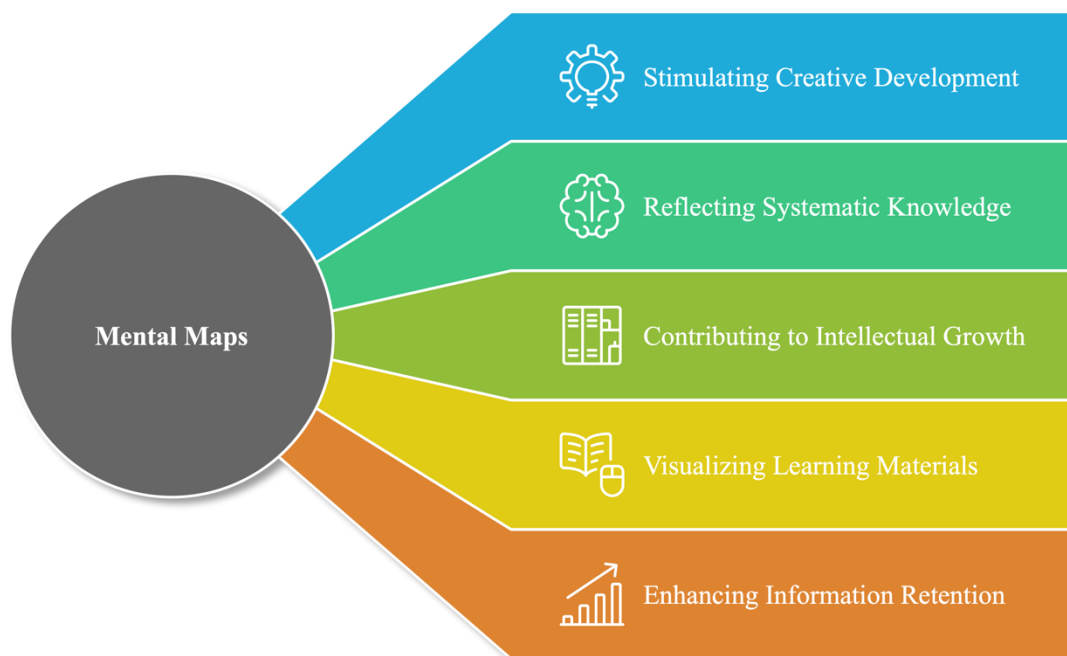
Mental maps, created using software or on paper, are a set of schemes and diagrams that visually demonstrate theses and thoughts united by a common idea and interconnected; a tool for displaying in visual form the process of structuring information and thinking; a convenient way to depict using schemes the process of systemic general thinking. The main keys are the elements of the map (triggers): drawings and words, each of which symbolizes a certain memory, helps to use the full potential of the mind, and contributes to the emergence of ideas and new thoughts (Lavrenova, 2019).

Mental maps, when studying a certain topic, are structural and logical schemes of content and procedural aspects, innovative tools in the training of specialists, which reflect in a radial form the connections of the key concept, which constitutes an indissoluble unity and is located in the center with other concepts of this problem (topic) and become obvious and visual for students, allowing them to look through the prism of their intersystem connections practically when studying each concept (Havrysh, 2007).
Mental maps (Fig. 1):

− Stimulate the creative development of each student in the modern educational environment of higher education;
− Reflecting the systematicity and integrity of the student's knowledge, ensuring the implementation of the principles of integrated education;
− Contribute to the development of new systems of views of higher education applicants and their intellectual development and search;
− Visualize the materials that need to be mastered and studied;
− Improve the processes of information processing and memorization by the individual (Souza Filho et al., 2021).

Figure 1. Unveiling the Multifaceted Benefits of Mental Maps.

That is why mental maps are defined in the educational process of higher education institutions as an innovative way of organizing information, which, through a radial presentation of the content of education, simultaneously actualizes the work of the figurative (right) and logical (left) hemispheres of the brain. The use of mental maps in cloud services allows for complementary mutual activity between students and the teacher, resulting in the complete awareness of the subjects of educational activity of a specific topic (Romanovskyi et al., 2018).

The essence of mental maps, which exist using graphic images, is the symbolization and systematization of information. Through the representation of the existing cognitive field or content or the creation of associations, systematization is reflected in mental maps.

At the same time, symbolization is provided by combining a sign with a word, picture, or symbol, for example (Leite & Rodrigues, 2021):

– Codes (symbols, figures, checkmarks, "minus", "plus" signs, etc.) encrypt information that is easy to "read" in different places on the map;
– The connection of concepts is shown by arrows located in different parts of the mental map;
– Geometric figures emphasize different associative rows on the map;
– The relationship between concepts (in different parts of the map) reflects color and highlights individual blocks of elements, combines structural components;
– Creative images and drawings facilitate memorization and perception, deepen the content, and associate with the theme of the intellectual map.

2. **Different positions of considering the mental map as an innovative tool in the training of specialists.**

The mental map as an innovative tool in the training of specialists in the modern educational environment of higher education is considered from two positions:

1) *As a tool for systematizing information and its visualization* – from the position of a scientific and pedagogical worker. The mental maps created by the teacher contribute to giving personal meaning to the information, which results in a lecture presentation for students with an orientation towards a radiant record decorated with associative meanings rather than a textual summary. The information presented by the teacher in the form of a mental map allows him to teach without a rigid attachment to

the text, while the holistic plan of the lecture information is always before the eyes of the teacher and the student (Romanovskyi et al., 2018);

2) ***As a technology for mapping and taking notes of educational information during lectures*** – from the position of a higher education student. At the same time, when it is necessary to remember a significant amount of information, structuring and constructing mental maps allows the student and teacher to save time. A mental map has several advantages over short notes or usual note-taking. A mental map allows you to understand the relative importance of each single idea, identifying the main idea that is placed (according to the location from the center) in the center of the sheet and using lines to capture the connections between key concepts. The structural nature of a mental map allows you to supplement it with new information without any corrections (Díaz Álvarez et al., 2023). Mental maps can be used in practical lecture classes and during independent work for creating presentations, developing projects of varying complexity, developing students' intellectual abilities, brainstorming, etc. (Pozdniakova, 2018).

A mental map allows you to structure and systematize the material, establish semantic and content connections, and monitor a certain development of events. Speaking about the skills and abilities of educational activities of higher education students that are necessary for training specialists in the modern educational environment of higher education, mental maps are a "means of simplification, schematic representation" of mental operations (of all types) that develop critical thinking, improve concentration, memory, and a sense of proportion. Mental maps, by setting up joint work of higher education students, attract their attention and make presentations and classes more meaningful and interesting; the material of the class can be easily adapted to changing conditions, and, thanks to mental maps, it becomes less cumbersome. Mental maps demonstrate constructiveness, consistency, and creativity and not only operate with factual material because they focus on information that directly relates to the subject being studied (Panina, 2020).

3. **Cloud services can be used in the process of developing mental maps when preparing seminars or lectures.**

Given the purpose of our study, we will analyze cloud services that can be used in the process of developing mental maps when preparing seminars or lectures and dwell in more detail on the position of using mental maps.

Coogle is an online application that provides a free plan for creating mental maps with the ability to create your own three diagrams in the free version. It has an awesome version that is suitable for professional or personal use by a student with additional features and increased security; it provides saving of the mental map in PDF format and has unlimited access to downloading images (Sulym et al., 2023).

MindMeister is a fairly easy-to-use program with a user-friendly interface. In the free version, you can build three Mental maps with the addition of links to video material, images, icons;
BubblUs is an online service, a relatively free web application that allows you to create mental maps relationship diagrams online, allows you to export in image format, and has an English-language interface. The disadvantage of the free version is the ability to create only three mental maps online and export them in image format (this is the only limitation), and the Premium version allows you to store up to 5 MB of information and upload images;
Popplet is an English-language service that is powerful and easy to use in terms of functionality. Allows you to create one mental map in the free version with the addition of videos from YouTube, images, and text, and also supports joint editing of the map by a group for teamwork (Stupak, 2022).
Mindomo – software for creating relationship diagrams using the Internet. It can create only three mental maps online in the free version and export them in image format for free;
MAPMYself (Mapul) – an online service for creating hand-drawn professional relationship diagrams built on SilvrLight. It can create only two mental maps online in the free version and export them in image format for free.

MindMeister – for those with small design requests, the program is worth paying attention to. MindMeister – supports export to pdf, MindManager 6 (Mmap), FreeMind (Mm), as well as to an rtf document or as an image (jpg, gif, png) – Web 2.0 application for building relationship diagrams, which can create only three mental maps online in the free version and export them in image format. It has a fairly wide functionality

even in the free version: different colors and styles of blocks, changing the font and color of the text (Balalaieva et al., 2023).

SpiderScribe – a free service (Adobe Flash). With this service, you can accompany ideas with documents, calendars, and images to visualize ideas. Map nodes can contain a picture (jpg, png), simple text, a map (GoogleMap), a date (calendar), or an attached file. Export to jpg and png supports the work of several people on one "mental map"; there are no problems with Cyrillic support, and the interface is English;

Xmind – the program works on Windows / Mac / Linux platforms, is one of the most popular programs for creating mental maps, and has several versions: paid with advanced functionality but free with reduced capabilities;

Freemind program – has the necessary set of functions for creating high-quality mental maps and is a completely free application that works on any platform supported by Java (Pozdniakova, 2018).

Mental maps involve students of all levels in organizing and solving educational and professional problems active creative thinking, are ideal for use in educational institutions, and can be used in any type of task (Knysh et al., 2023).

4. **Types of mental maps in the modern educational environment of higher education.**

There are different types of mental maps depending on the scope or application:

– *Standard maps* – classic mental maps that serve to reveal one's own individuality, assimilate, and record ideas;
– *Speed maps* – mental maps that stimulate thought processes. A map can be, for example, a short one-color summary made before a lesson or flash cards – for better assimilation of the studied material;
– *Master maps* – maps for an entire field of knowledge, very voluminous, for example, based on materials from one semester – intended for a general overview of the entire topic and are compiled continuously;
– *Mega maps* – mental maps that are connected to each other (Reichert Coelho & da Silva Mendes, 2019).

A map with a relatively small number of levels – the central map is connected to the following maps, which present additional aspects or details. It increases the cognitive interest of students and the effectiveness of learning. Mental maps are appropriate at different stages of classes in the modern educational environment of higher education. They help to implement the principle of clarity, one of the principles of pedagogy, because they contribute to covering the subject of the subject at a glance. The most important thing in associative comparisons and connections is shown by the flowchart. The use of mental maps during the study of new material reduces the risk of misinterpretation of important concepts and helps the teacher to convey to the students a generalized clear idea of the material being studied (Buzan & Buzan, 1993).

5. **Using online resources to create interactive online mental maps.**

The current level of development of information and communication technologies allows the creation of interactive mental maps using online resources. A significant number of online services exist for creating mental knowledge. The most common of them are Bubbl.us, FreeMind, XMind, Zoho, MindMeister, Mindomo, Mind42, Gliffy, and many others. Online mental maps created by a teacher can be used in the educational process by opening comments to the blocks of the mental map, as a lecture outline, viewing video files and pictures, opening other online resources from hyperlinks, step by step revealing a certain topic to students, using elements of clarity in this educational process. With the help of mental maps, the material will be better perceived by students and will be much more interesting (Lavrenova, 2019).

So, summing up the above, we can conclude that the use of online resources when creating interactive mental maps online provides the following opportunities in the educational process of higher education:

– Generate ideas;
– Improve memory;
– Inspire the search for a solution;
– Recall words, facts, images;
– Demonstrate concepts and diagrams;

- Structure work;
- Analyze events or results;
- Organize interaction in role-playing games or group work;
- Effectively process and structure data;
- Summarize the work done.

The use of online resources when creating interactive mental maps online provides the construction of mental maps either "by hand" or on paper, which contributes to maintaining the comfort of the student's thinking and activating the person's creative thinking (Romanovskyi et al., 2018).

When creating interactive online mental maps, it is necessary to adhere to a certain algorithm:

1) ***Determine the main idea, the object of study*** (central concept) – the teacher's area of responsibility;
2) ***Select the main branches from the main concept*** (basic structural units) that are related to the main object – the teacher's area of responsibility;
3) ***Supplement the mental map with branches that depart from the structural units*** (additional information) – the student's area of responsibility;
4) ***Arrange branches with words around the main node*** (main concept) – the student's area of responsibility;
5) ***Consider exaggerated or incompletely reproduced structural nodes*** (if necessary, editing the mental map) – the collective area of students and the lecturer (Leandro & Canto, 2019).

Independent construction (depending on the task that needs to be solved) by students of a mental map according to the specified algorithm can provide for an author's approach at all stages of educational activity.

Let's reveal the basic **rules for building Mental mapping**:

1) The object of attention is concentrated in the very center of the subject of activity;
2) The main subtopics related to the object of attention diverge from the branch, central image, or idea;
3) Taking the form of smooth lines, the branches are explained or indicated by key images or words. Microthemes (secondary ideas) are also depicted by branches that depart from subideas – branches of a higher order;
4) A connected nodal system is formed by branches. Higher education students can create a mental map on flipcharts, on the board independently, on separate sheets of paper in their notebooks;
5) Building maps does not require special artistic abilities: you need to have colored pencils or chalk, imagination, and an idea;
6) You can also create mental maps using separate services http://cooggle.it; http://app.popplet.com, etc., and computer programs (MindMap, ConceptDraw, MindMapper, etc.) (Buzan, 2018).

The construction of individual mental maps by students of higher education will allow the teacher to assess the level of understanding of the educational material by students and will help the students themselves to comprehend, critically analyze, and select the main information. The graphic method of presenting information allows for better memorization, systematization, and assimilation of the material, captivates students during learning – and, as a result, improves thinking and memory, which has a positive effect on the results of the educational achievements of future specialists (Shuliak et al., 2022).

6. **Rules for creating and advantages of a mental map as an innovative tool in the training of specialists in the modern educational environment of higher education.**

You need to know the basic rules for creating mental maps for their direct creation and innovative use:

- The hierarchy of thought cannot be violated;
- The main branches of the mental map should be bold, resembling tree branches or octopus tentacles;
- The use of different colors for the main branches is mandatory, which helps in a structured and holistic perception of the material;
- The central concept of the mental map must necessarily contain at least three colors (color image). You can use words, but this is not a mandatory condition;

– The branches must reproduce emotions and rhythm; be zigzag, wavy, and "alive"; of different thicknesses;
– You can put the branches that have grown into the contours to have the least intersection with neighboring branches;
– The length of the line should be equal to the length of the word, which will save space and simplify the work;
– It is important to place words not in parallelepipeds and rhombuses but on branches, etc.;
– Symbols and words that are connected to each other should be connected with a dotted line;
– You need to write as clearly and clearly as possible in printed letters;
– In real interactive online mental maps, keywords are used: one word per branch: not a sentence, not a phrase, but one keyword. New ideas are generated by writing words separately, and each word gives rise to thousands of possible associations;
– It is necessary to vary the thickness of the lines and the size of the letters depending on the significance of the keyword;
– It is necessary to often use graphic symbols and drawings, thanks to which attitudes and emotions are added, emphasizing certain aspects. A mental map can consist only of drawings;
– It is necessary that the branches are not placed too densely, and at the same time, there is no space left so that it does not. For a large topic of a mental map, you should use a sheet of paper in A3 format, and for a small one, use a sheet of paper in A4 format;
– For more convenient work with a mental map, it is better to place the sheet of paper horizontally (Shcherbatiuk, 2020).

Let's name the advantages of a mental map as an innovative tool in the training of specialists in the modern educational environment of higher education. Let's consider the advantages of a mental map as an innovative tool in the training of specialists in the modern educational environment of higher education:

– The principle of creating a mind map is useful for summarizing any discipline during lessons. All information on the educational topic is transformed into associative connections of educational concepts, and the generalization of data on the topic is displayed in a single image;
– When taking notes on large topics, you can build a mental map – instead of spending time writing down materials and long notes, the student forms only one flowchart;
– A mental map helps in implementing the principle of clarity – one of the most important principles of pedagogy and allows, like a flowchart, to cover everything at a glance, to show everything most important in associative connections and comparisons;
– The mental mapping method allows students to develop creative thinking;
– Using a mental map helps to increase students' concentration;
– A mental map develops skills and logic, increases the intensity and quality of learning, and trains memory;
– With the help of mental maps and their graphic appeal, the process of generating ideas becomes more effective and faster (Hyria, 2022);
– Mental map ensures the quality of education, helps to increase student motivation and competitiveness in the labor market;
– Mental map promotes the activation of student activity, the development of emotional intelligence, communication, and the organization of interaction between higher education students in group work;
– When determining social, personal, or professional goals, making a certain decision, and determining the student's life values – promotes self-analysis and reflection;
– Ensures the creation of an atmosphere of productive dialogue and relaxed communication (Sydoruk, 2020).

7. The experimental research.

The experimental work was carried out without violating the structure of classes in the conditions of the current educational process of higher education and the content of the curriculum provided for by the curricula. The main base for experimenting was higher education institutions.

In the process of the ascertaining experiment, the CG and EG of students were determined, and the levels of readiness of future specialists for the development and application of mental maps as an innovative tool in the modern educational environment of higher education were studied. In this case, experimental research

methods were used: observation, questionnaires, interviews, and surveys.

The ascertaining stage of the study was carried out in the modern realities of higher education to develop a diagnostic apparatus, identify the state of the problem under study, and determine its pedagogical feasibility and relevance, the formation of students' independent work. First-year undergraduate students participated in the ascertaining stage of the study.

At the ascertaining stage, a question was proposed to clarify the feasibility of using and the ability to use mental maps as an innovative tool in the training of specialists in the modern educational environment of higher education.

The question was proposed: "How do you understand mental maps? Explain the different positions of considering a mental map," which caused difficulties for the respondents of the EG and CG.

Thus, only 12% of the surveyed first-year students were able to reveal the essence of this concept and the different positions of considering a mental map.

The answers of higher education applicants to the question "Name the cloud services that can be used in the process of developing mental maps when preparing seminar or lecture classes?" demonstrated ignorance of these cloud services.

Thus, only 15% of students understood this question and named the online applications Coogle and MindMeister, which are designed for creating mental maps and have a free tariff plan.

At the same time, 85% of respondents noted that they listen attentively and remember and record lectures from the teacher.

Only 15% of higher education applicants use the mental map method, the thesis method, and the schematic method among the lecture note-taking methods in their studies.

Answers to the final last question "Is it necessary for students to use mental maps in professional training in the modern educational environment of higher education and to introduce a special course for high-quality training?"

Thus, 78% of respondents stated the need to use mental maps in professional training in the modern educational environment of higher education and to introduce a special course on this problem: "The use of mental maps in professional training of students in the modern educational environment of higher education for high-quality training".

22% of respondents believe that such a special course is not needed but confirmed the importance of using mental maps in professional training.

Despite the relevance of this problem for education, the majority of respondents (62%) were found to have elementary and reproductive levels of awareness of this problem.

The experimental work was carried out without violating the structure of classes in the current educational process of higher education and the content of the curriculum provided by the curricula. The main base for the experiment was higher education institutions.

In the process of the ascertaining experiment, the CG and EG of students were determined, and the levels of readiness of future specialists to develop and use mental maps as an innovative tool in the modern educational environment of higher education were studied. In this case, experimental research methods were used: observation, questionnaires, interviews, and surveys.

The ascertaining stage of the study was carried out in modern realities of higher education to develop a diagnostic apparatus, identify the state of the problem under study, determine its pedagogical feasibility and relevance, and form students' independent work. First-year undergraduate students participated in the ascertaining stage of the study.

At the ascertaining stage, a question was proposed to clarify the feasibility of using and the ability to use mental maps as an innovative tool in the training of specialists in the modern educational environment of higher education. The results obtained indicate that university students were not prepared to work with mental maps in professional training in the modern educational environment of higher education for high-quality learning, that is, students who had recently entered the university did not have practical skills in working with mental maps, did not know cloud services that can be used in the process of developing mental maps in the preparation of seminar or lecture classes; could not name the types of mental maps in the modern educational environment of higher education, did not know the rules for creating and the advantages of a mental map.

The role of the teacher, in this case, was to assist students in working with mental maps, formulating the correct question for the teacher, and using cloud services that can be used in the process of developing mental maps when preparing seminars or lectures.

So, it can be said that while studying in a general education school, future students have low-level skills in working with mental maps.

At the formative stage of the experiment, pedagogical conditions were introduced, and a special course "The use of mental maps in the professional training of students in the modern educational environment of higher education for high-quality learning" was developed, which was introduced in the EG, and the CG studied according to the usual methodology.

The identified pedagogical conditions that were implemented at the formative stage of the experimental study were as follows: activation of students' cognitive activity as a basic pedagogical condition for forming the ability to use mental maps in classroom and independent work, use of formative assessment of the use of mental maps as a determining condition for the educational activity of future specialists, personalization of learning as a dominant condition for the use of mental maps in higher education.

Pedagogical conditions were experimentally integrated in the first year of undergraduate studies into the educational process of higher education. To create mental maps, students used the method of collecting ideas and thoughts or brainstorming, etc.

48 EG students and 46 CG students participated in the experiment, which corresponds to the calculation data because the sufficient sample size is 43.

Therefore, the analysis of the results shows that at the beginning of the formative stage of the experiment, EG and EG did not have significant differences in the levels of understanding of the essence of using mental maps in higher education.
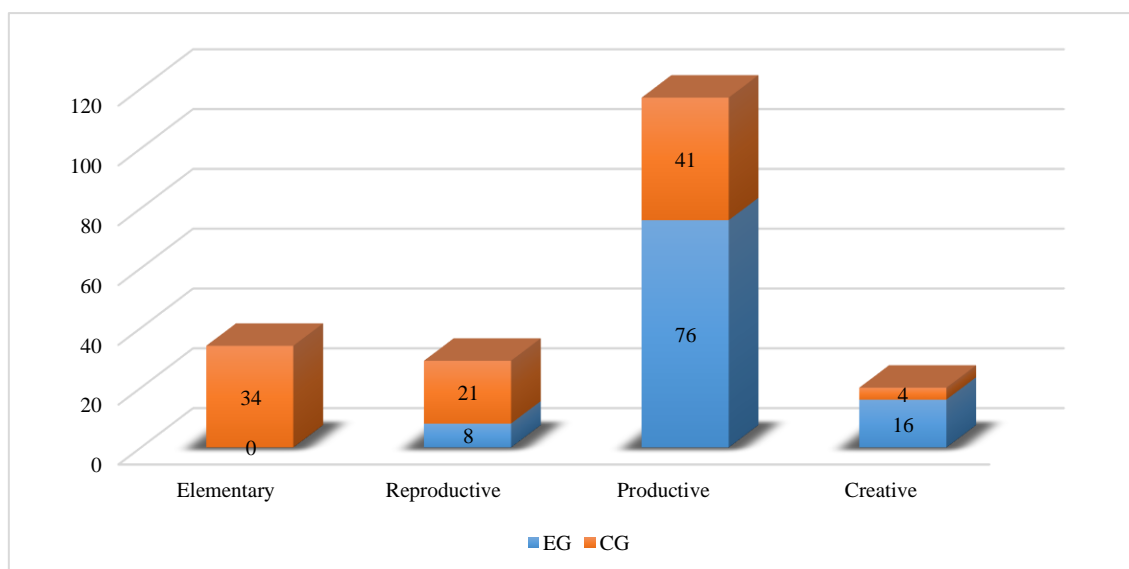
At the end of the formative experiment, a control section and statistical analysis of the level of use of mental maps by EG and CG students were carried out.

According to the results of the study, to implement pedagogical conditions in the process of implementing a special course, we observed the effectiveness of the introduced approaches, methods, types of work, and forms. Thus, EG respondents showed a significantly higher level of success, working independently with mental maps and completing individual tasks.

Comparison of EG and CG by levels of creation and use of mental maps shows a significant percentage difference when distributing students between EG and CG.

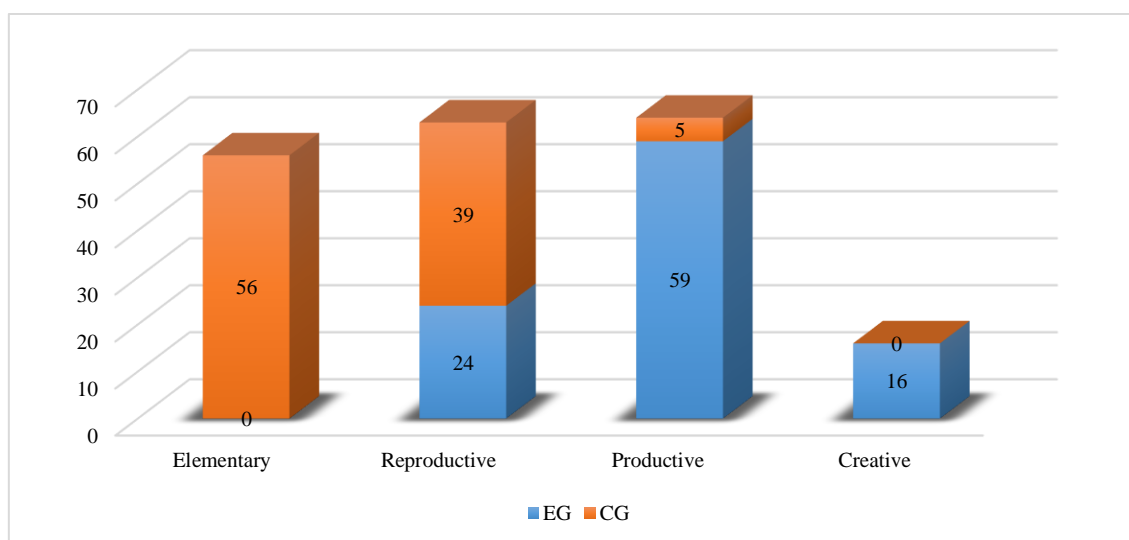**By motivational criterion (Fig. 2):**

−   In EG, 0% of respondents with elementary level, 8% – with reproductive level, 76% – with productive level, 16% – with creative level;
−   In CG, 34% of respondents with elementary level, 21% – with reproductive level, 41% – with productive level, and 4% – with creative level.

Figure 2. Comparison of EG and CG by Levels of Motivation.

By cognitive criterion (Fig. 3):

− In EG, 24% of respondents with reproductive level, 59% – with productive level, 16% – with creative level;
− In CG, 56% of respondents with elementary level, 39% – with reproductive level, and 5% – with productive level.
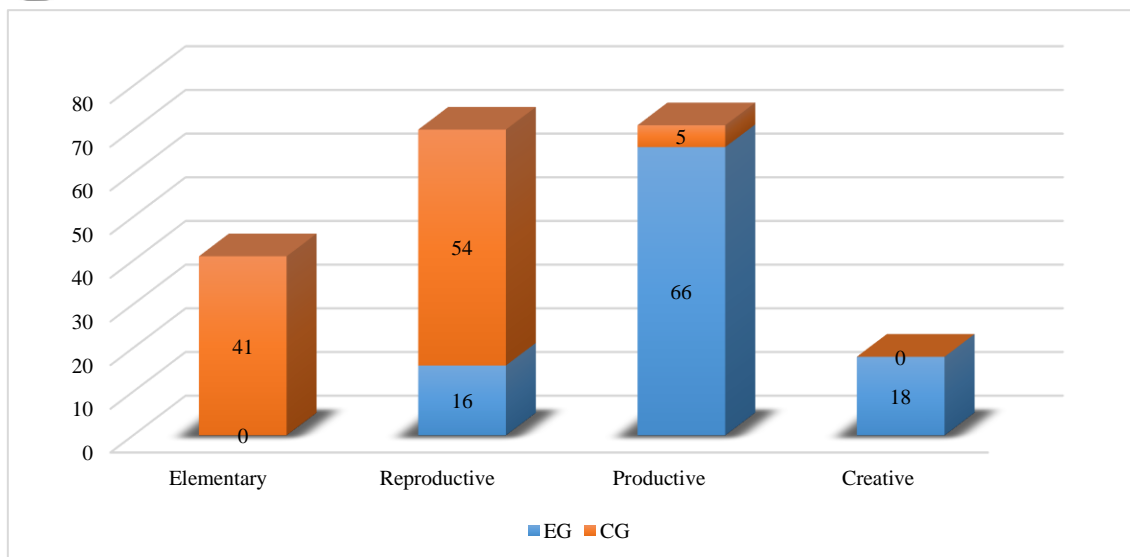

Figure 3. Cognitive Level Distribution in EG and CG.

By activity criterion (Fig. 4):

− In the EG, 16% of respondents with a reproductive level, 66% – with a productive level, 18% – with a creative level;
− In the CG, 41% of respondents with an elementary level, 54% – with a reproductive level, and 5% – with a productive level.
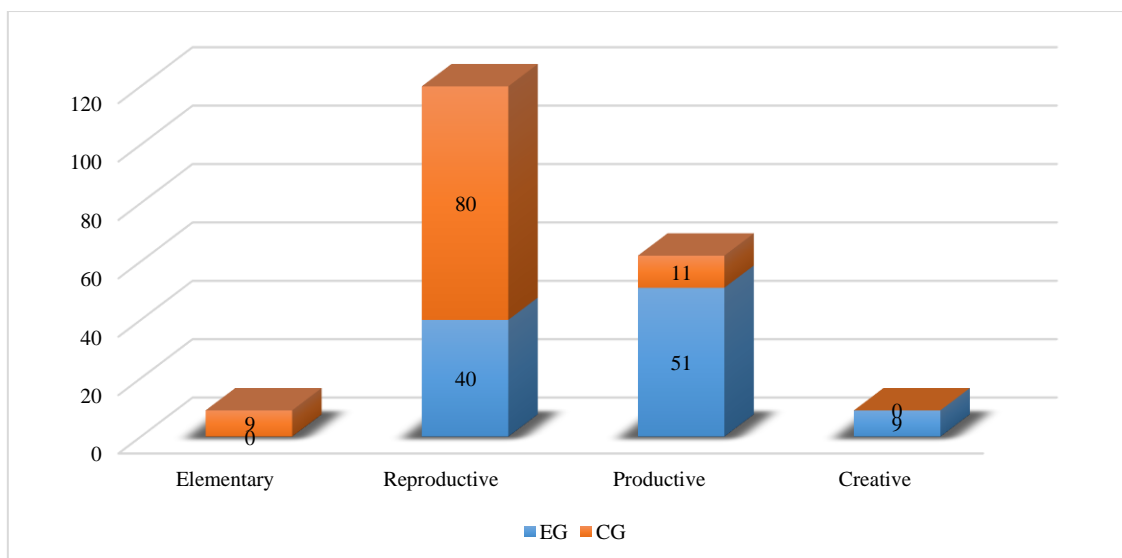
Figure 4. Distribution of Respondents by Activity Level.

By evaluation criterion (Fig. 5):

− In the EG, 40% of respondents with a reproductive level, 51% – with a productive level, 9% – with a creative level;
− In the CG, 9% of respondents with an elementary level, 80% – with a reproductive level, and 11% – with a productive level.

Figure 5. Distribution of Respondents by Evaluation Criterion.

So, thanks to the implementation of pedagogical conditions in the process of introducing a special course in the EG, we observed the effectiveness of the introduced approaches, methods, types of work, and forms. Thus, the EG respondents showed a significantly higher level of success, working independently with mental maps and completing individual tasks. We observe that students have a desire to continuously learn both online and offline; the desire to use digital technologies has increased; interest in education has increased; research, critical, project thinking has been formed; a culture of joint activity and the ability to build individual educational trajectories have developed; experience of mutual assessment and self-assessment has been formed; interest has arisen in involving mental maps as a tool when studying in higher education, which helped students take responsibility for the process of acquiring skills and abilities, and develop effective learning strategies throughout their lives.

A comparison of quantitative and qualitative analyses of the experimental results indicates that the implementation of pedagogical conditions in the process of introducing a special course in EG according to the components of the diagnostic apparatus led to statistically significant changes, an increase in scores on motivational, cognitive, activity and evaluation criteria, and therefore we observe positive dynamics in the use of mental maps by higher education applicants and their positive impact on the process of training specialists in the modern educational environment of higher education. As a result of the experiment, a non-parametric method of testing statistical hypotheses was used to verify the reliability of the conclusions – the Wilcoxon test. The processing of experimental data allowed us to verify the application of statistical methods and obtain confirmation of the correctness of the research methodology and the achievement of the set goal.

Discussion of the results of the work already done by scientists from different countries (disclosure by scientists of the essence and features of the use of mental maps in the modern educational space, characterization of the main areas of cooperation of educational institutions, etc.) required further development. Therefore, comparing the results of already conducted studies and analyzing their consequences, we set the goal of proving the effectiveness of the mental map as an innovative tool for training specialists in the modern educational environment of higher education. To this end, we developed a diagnostic apparatus, identifying the state of the problem under study determining its pedagogical feasibility and relevance, and forming students' independent work. The results of the formative stage of the experiment proved the effectiveness and feasibility of the developed methodology, to effectively use the mental map as an innovative tool for training specialists in the modern educational environment of higher education.

Research limitations.

The experimental study was developed in the conditions of a real educational process and was implemented during the 2022–2024 academic years. The experimental study covered higher education applicants (1st-2nd year students of higher education institutions) – 94 respondents at the ascertaining and formative stages of the study.

Future research directions.

We consider the prospect of further research to be the disclosure of the possibilities of other innovative technologies that can be used in the process of training future specialists and the formation of their social competence.

The use of mental maps in cloud services allows for mutually complementary activities of the teacher and students, resulting in the most complete awareness of a specific topic by the subjects of educational activity. The next area of scientific exploration on the presented problem is the analysis of the effectiveness of mental maps in the planning and reporting of students studying remotely.

Conclusions

We have revealed the content and considered the mental map from the perspective of innovative training of specialists in the modern educational environment of higher education. Different positions of considering the mental map as an innovative tool in training specialists are shown. Cloud services are presented that can be used in the process of developing mental maps when preparing seminar or lecture classes, and types of mental maps in the modern educational environment of higher education are distinguished. The use of online resources is proposed when creating interactive mental maps online. The rules for creating them are developed, and the advantages of a mental map as an innovative tool in the training of specialists in the modern educational environment of higher education are shown.

The experimental work was carried out without violating the structure of classes in the conditions of the current educational process of higher education and the content of the curriculum provided for by the curricula. The main base for the experiment was higher education institutions.

In the process of the ascertaining experiment, the CG and EG of students were determined, and the levels of readiness of future specialists to develop and use mental maps as an innovative tool in the modern

educational environment of higher education were studied. In this case, experimental research methods were used: observation, questionnaires, interviews, and surveys.

The ascertaining stage of the study was carried out in the modern realities of higher education to develop a diagnostic apparatus, identify the state of the problem under study, and determine its pedagogical feasibility and relevance, the formation of students' independent work. First-year undergraduate students participated in the ascertaining stage of the study.

At the ascertaining stage, questions were proposed to clarify the feasibility of using and the ability to use mental maps as an innovative tool in the training of specialists in the modern educational environment of higher education. The results obtained indicate that university students were not prepared to work with mental maps during professional training in a modern educational environment of higher education for high-quality learning, that is, students who had recently entered the university did not have practical skills in working with mental maps, did not know cloud services that can be used in the process of developing mental maps when preparing seminar or lecture classes; could not name the types of mental maps in a modern educational environment of higher education, did not know the rules for creating and the advantages of a mental map.

At the formative stage of the experiment, pedagogical conditions were introduced, and a special course "Using mental maps during the professional training of students in a modern educational environment of higher education for high-quality learning" was developed, which was introduced in the EG, and the CG studied according to the usual methodology.

The experiment was attended by 48 EG students and 46 CG students, which corresponds to the calculation data since the sufficient sample size is 43.

A comparison of the quantitative and qualitative analyses of the experiment results indicates that the implementation of pedagogical conditions in the process of introducing a special course in EG according to the components of the diagnostic apparatus led to statistically significant changes, an increase in scores on motivational, cognitive, activity and evaluation criteria, and therefore we observe positive dynamics in the use of mental maps by higher education applicants and their positive impact on the process of training specialists in the modern educational environment of higher education.

As a result of the experiment, a non-parametric method of testing statistical hypotheses was used to verify the reliability of the conclusions – the Wilcoxon criterion. The processing of experimental data allowed us to verify the application of statistical methods and obtain confirmation of the correctness of the research methodology and the achievement of the set goal.

The experimental study was developed in the conditions of a real educational process and was implemented during the 2022–2024 academic years. The experimental study covered higher education applicants (1st-2nd year students of higher education institutions) – 94 respondents at the ascertaining and formative stages of the study.

We consider the prospect of further research to be the disclosure of the possibilities of other innovative technologies that can be used in the process of training future specialists and the formation of their social competence. We see prospects for further research in analyzing the effectiveness of using mental maps when performing tasks by high school students in distance learning environments.

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