https://doi.org/10.34142/2709-7986.2026.31.1.22

EFFECTIVENESS OF USING MIND MAPS IN THE LEARNING PROCESS: TEACHERS' PERSPECTIVES AND STUDENTS' ASSESSMENTS

ЕФЕКТИВНІСТЬ ЗАСТОСУВАННЯ МЕНТАЛЬНИХ КАРТ В НАВЧАЛЬНОМУ ПРОЦЕСІ: ПОГЛЯД ВИКЛАДАЧІВ ТА ОЦІНКА СТУДЕНТІВ

Received: March 30, 2026 **Accepted:** May 27, 2026 **Published:** May 29, 2026

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How to Cite this Article (APA Style):

Havrylenko, K., Popovych, A., Shemetenko, O., & Yemets, T. (2026). Effectiveness of using mind maps in the learning process: Teachers' perspectives and students' assessments. *Educational Challenges, 31*(1), 318–328. https://doi.org/10.34142/2709-7986.2026.31.1.22

ABSTRACT

Purpose. *The study aims to analyze the experience of integrating mind mapping into the "Medical Biology" course for first-year medical students. The rationale is driven by the need to overcome the barriers of "clip thinking" in Generation Z and to transform traditional note-taking methods into active visual structuring tools to manage the increasing volume of medical information and improve preparation for the KROK-1 (an exam in general scientific disciplines, which is taken by applicants for medical and pharmaceutical education after studying the main fundamental disciplines) licensing examination.*

Methodology. *A comprehensive study was conducted during the autumn semester of 2025 at Zaporizhzhia State Medical and Pharmaceutical University. The sample included 42 first-year medical students (31% of the specialty cohort). The educational intervention involved creating mind maps for key modules, including: "Molecular-cellular level of life organization", "Laws of heredity and variability", "Methods of studying human heredity. Hereditary diseases", using digital platforms (Canva, Miro, Coggle) or paper media. Data were collected through an anonymous Google Forms survey using a Likert scale and analyzed using descriptive statistics in Microsoft Excel.*

Results. *Most students (92.9%) had little to no prior experience with mind mapping. 92.9% chose digital tools over paper, with Canva (50%) being the most popular platform. 95.2% of respondents confirmed that mind maps significantly improved material structuring, and 83.3% reported a*

Мета. *Метою дослідження є аналіз досвіду інтеграції ментальних карт у курс «Медична біологія» для студентів першого курсу медичних спеціальностей. Актуальність роботи зумовлена необхідністю подолання обмежень кліпового мислення покоління Z і трансформації традиційних способів конспектування в інструменти активного візуального структурування знань для опрацювання дедалі більших обсягів медичної інформації та підвищення ефективности підготовки до ліцензійного інтегрованого іспиту «КРОК-1».*

Методологія. *Комплексне дослідження було проведено протягом осіннього семестру 2025 року в Запорізькому державному медико-фармацевтичному університеті. Вибірка склала 42 студента першого курсу спеціальності «Медицина» (31% від загальної кількості на курсі). Освітнє втручання передбачало створення ментальних карт до ключових змістовних модулів: «Молекулярно-клітинний рівень організації життя», «Закономірності спадковості і мінливості», «Методи вивчення спадковості людини. Спадкові хвороби», з використанням цифрових платформ (Canva, Miro, Coggle) або паперових носіїв. Дані збиралися за допомогою анонімного опитування в Google Forms із використанням шкали Лайкерта та аналізувалися методами описової статистики в Microsoft Excel.*

Результати. *Більшість студентів (92,9%) мали незначний попередній досвід роботи з ментальними картами або зовсім його не мали. У ході дослідження 92,9% респондентів надали перевагу цифровим інструментам, серед яких найпопулярнішою платформою стала Canva (50%). 95,2% опитаних підтвердили, що ментальні карти*

better understanding of cause-and-effect relationships. 100% of students found the method beneficial for independent literature review. Key elements identified as most effective were "Keywords" (59.5%) and "Branches" (40.5%), while "Color" (9.5%) and "Central Image" (11.9%) were rated lower. Time investment for most students (54.8%) was 1–2 hours per map. 88.1% of participants rated mind mapping as more effective than traditional linear note taking.

Conclusions. *Mind mapping is a highly effective didactic tool that promotes active knowledge of construction and self-regulated learning in medical education. The preference for keywords and hierarchical branches reflects a pragmatic approach to learning, specifically tailored for identifying diagnostic markers in medical tests. To optimize the method, multimedia instructions for various digital platforms should be provided. Students' high motivation and request for cross-disciplinary integration suggest that mind mapping should be formally incorporated into the medical curriculum as a tool for synthesizing complex biological data.*

Keywords: *concept maps, learning methods, medical biology, medical education, medical students, mind maps.*

суттєво покращили структуризацію матеріалу, а 83,3% відзначили краще розуміння причинно-наслідкових зв'язків. 100% студентів визнали метод корисним для самостійної роботи з літературою. Ключовими елементами, визначеними як найбільш ефективні, стали «Ключові слова» (59,5%) та «Гілки» (40,5%), тоді як «Колір» (9,5%) та «Центральний образ» (11,9%) отримали нижчі оцінки. Часові витрати для більшості студентів (54,8%) склали 1–2 години на одну карту. 88,1% учасників оцінили ментальні карти як більш ефективні порівняно з традиційним лінійним конспектуванням.

Висновки. *Ментальні карти є високоефективним дидактичним інструментом, що сприяє активному конструюванню знань та саморегульованому навчанню в медичній освіті. Перевага, надана «ключовим словам» та «ієрархічним гілкам», відображає прагматичний підхід до навчання, орієнтований на ідентифікацію діагностичних маркерів у медичних тестах. Для оптимізації методу слід забезпечити мультимедійний супровід для різних цифрових платформ. Висока мотивація студентів та запит на міждисциплінарну інтеграцію свідчать про доцільність офіційного включення ментальних карт у навчальний план як інструменту для синтеза складних біологічних даних.*

Ключові слова: *концептуальні карти, медична біологія, медична освіта, ментальні карти, методи навчання, студенти-медики.*

INTRODUCTION

Modern medical education is undergoing transformation driven by the rapid growth of scientific information, technological progress, and changes in the cognitive profiles of students (Miguez-Pinto et al., 2025; Aljamal et al., 2025). The study of medical biology is the foundation of clinical thinking, but traditional teaching methods often prove insufficient for mastering complex molecular-genetic and cellular mechanisms (Kralova, 2017; Popovich & Aliyeva, 2024; Popovych & Aliyeva, 2025). Recent data show that classical note-taking is gradually losing its relevance, giving way to methods of visual structuring (Shuliak et al., 2022; Burlacu, 2025).

The relevance of this study is due to the phenomenon of 'clip thinking' characteristic of Generation Z, born between the mid-1990s and mid-2010s. This type of thinking is characterised by low concentration, difficulty reading long texts, rapid loss of focus, inability to deeply understand and generalise what has been read, and the dominance of visual perception over textual perception (Havrylenko et al., 2023; Sajadi et al., 2024; Abdel-Hamid et al., 2017).

For such learners, classical teaching methods become a barrier, while mind maps offer a non-linear approach that corresponds to the natural work of the brain through associative connections. At the empirical level, it has been proven that mental maps have a positive effect on the formation of subject competence, help to organize and systematize scientific information, group scientific data and thoughts, find new ideas,

plan work, assess its scope, and summarize scientific achievements in a certain field of research (Hyria, 2022).

British researcher Tony Buzan proposed the use of mind maps as a reflection of “radiant thinking”. His theory is based on the fact that the brain works most effectively when we combine the logic of the left hemisphere with the creativity of the right. The map model resembles a “radiant”: in the center is the main idea, and from it, like rays, associations diverge. This approach helps not just to mechanically record data, but to create your own network of symbols, which makes the learning process creative and significantly improves memory (Romanovskyi et al., 2018).

The **aim** of our work was to analyse the experience of using mind maps in medical biology classes during the semester and to evaluate their impact on learning effectiveness based on a student survey.

METHODOLOGY

A comprehensive approach combining theoretical and empirical research methods was used in the course of the work. Over the course of one semester (September-December 2025), tasks for constructing mind maps based on content modules were integrated into the educational process: Molecular-cellular level of life organization,’ Patterns of heredity and variability,’ "Methods for studying human heredity. Hereditary Diseases." In the first class, students received methodological recommendations for creating mind maps.

They were offered a choice of digital tools: Coogle, XMind, Canva, Xmind, Miro; or paper media. Students created maps during classroom sessions to systematize new material, as well as during independent study to summarize the topic. The work was carried out in small groups, but some students worked alone.

During the sessions, students gave presentations, and the lecturer analyzed maps focusing on the correctness of the logical connections. To assess the effectiveness of the method, an anonymous survey was conducted at the end of the semester. The data obtained was processed using mathematical statistics methods with Microsoft Excel software.

RESULTS

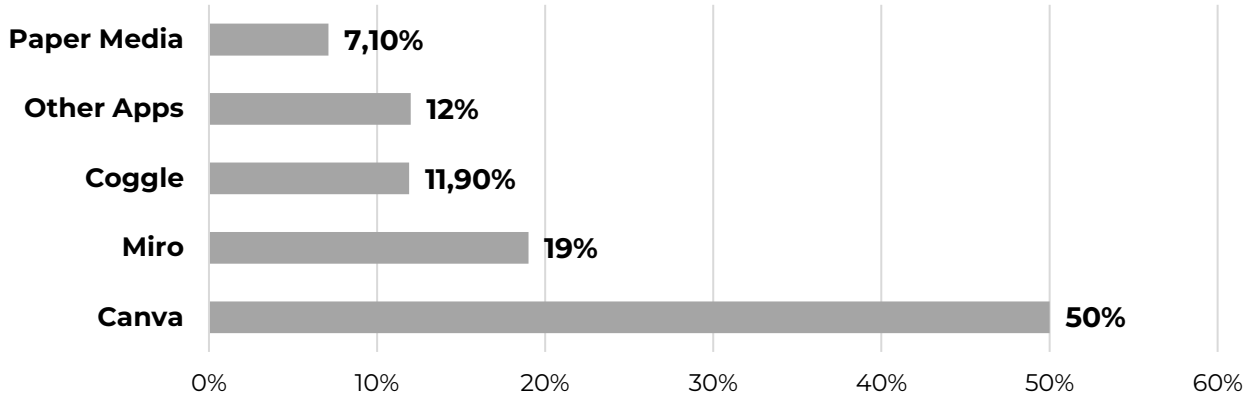
Respondents who voluntarily agreed to participate in the survey were guaranteed complete anonymity. The survey was conducted using a Google form. Forty-two first-year students majoring in medicine at Zaporizhzhia Medical and Pharmaceutical University participated in the survey, representing 31% of the total number of students in this major.

According to the survey results, half of the respondents indicated that they had no previous experience in using mind maps, 42.9% used them occasionally, and only 7.1% of students used them regularly.

To create mind maps, students were offered a choice of digital platforms for online work, paper media, or digital platforms for classroom work. Only 7.1% of respondents chose paper media for their work, while the rest of the students used applications. The most popular platforms are indicated in Figure 1.

Figure 1

Student platform choices for Mind Mapping (%)



The main focus of our research was on the feasibility of using mind maps in class. Therefore, important question was to determine how much mind maps helped students structure the material of the topic when preparing for class. For the assessment, we used Likert's scale, where respondents rated their degree of agreement or disagreement on an ordered scale (from 'Did not help at all' to 'Helped significantly').

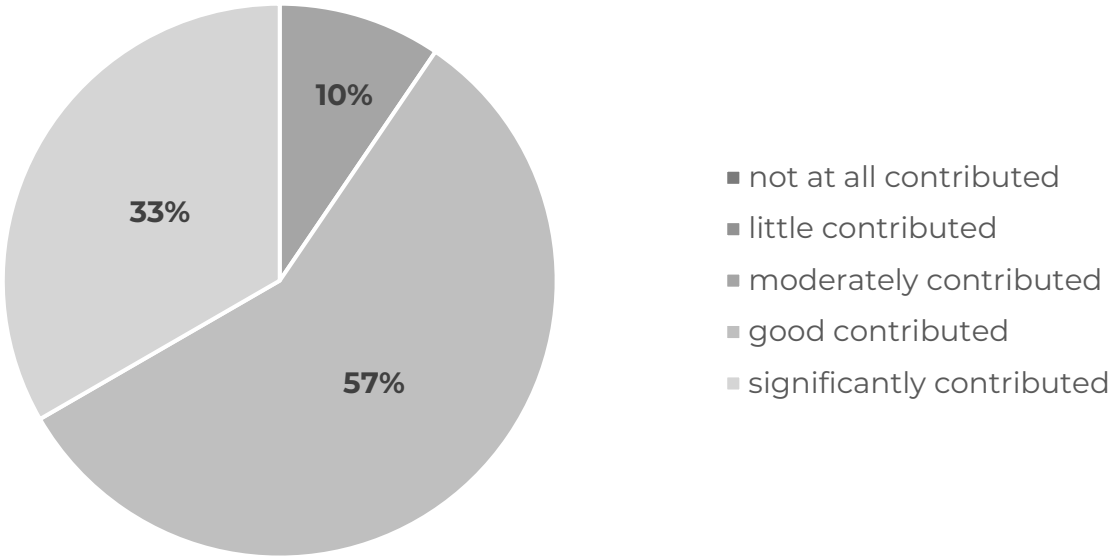
Almost unanimously (95.2%), students agreed that mind maps helped them structure academic material of the topics studied. 35.7% responded that the maps helped 'significantly,' and 35.7% responded that they helped 'well.' Another 4.8% felt that the maps were 'moderately' helpful.

When asked whether creating a mental map helped them better understand the cause-and-effect relationships between processes and concepts, 83.3% answered 'yes,' 14.3% noted partial benefit, and only 2.4% (n=1) did not find it helpful.

The respondents' experience shows that the use of mind maps greatly facilitates the process of studying literature without outside help. The respondents' answers are shown in Figure 2.

Figure 2

Subjective assessment by respondents of the effectiveness of working with information sources using mind maps



90.5% of respondents noted that creating mind maps was a motivational and creative task. 7.1% partially felt this function, and 2.4% (n=1) did not see any benefit.

We wanted to understand which elements of mind maps are key to understanding the topic. The survey results are shown in Table 1. Only 11.9% of respondents noted the 'central image' as a key element of a mind map. However, it is important for focusing attention and triggering associative thinking, and is the focal point of the map. We believe that this indicator is low because the central image is often a picture. Meanwhile, 38.1% of respondents voted for the importance of the 'Image'. Images are indeed an important element of maps, as we process visual information faster and remember it more quickly.

For each topic, we gave students a table with KROK tests, where they had to identify 'Key Words' and incorporate them into the mind map. This is necessary for preparing for the KROK and for associative memorisation, which makes the map easy and flexible to read. 59.5% of respondents voted for the importance of 'Keywords'. Surch element as 'Colour' divides information into logical zones, which helps to structure the map in memory.

In our survey, 9.5% of students noted the importance of this element. We believe that this indicator is low because one topic contains many blocks that are not simplified by colouring them in different colours and may even interfere. Therefore, the use of colour may be more appropriate if the topic has a small number of blocks. 'Branches' and 'Arrows' are important details of mind maps. They were voted for by 40.5% and 28.5% of respondents, respectively. Branches represent key sections of a topic and provide detailed information. Arrows show the non-linearity of interactions between concepts (Table 1).

Table1

The most useful elements of a mind map according to students

Mind map elements	Number of responses	Percentage of total
Central Image	5	11,9%
Keywords	25	59,5%
Image	16	38,1%
Branches	17	40,5%
Arrows	12	28,5%
Color	4	9,5%

During the classes, students worked on the topic in groups and then created mind maps. Then, each team presented their map to the whole class. After the presentation, students could ask the presenters questions or clarify the information provided. According to the survey, 90.5% of respondents said that they understood the topic better, and 9.5% said that it was partially useful.

It was also key for us to determine the effectiveness of mind maps compared to traditional methods, in particular, note-taking. 28.6% of respondents noted the significant effectiveness of maps, 59.5% recognised their overall effectiveness, and 11.9% noted moderate effectiveness.

To obtain feedback, students' experience in working with mind maps was analyzed. In particular, the time spent on creating mind maps, the cognitive accessibility and practical value of the instructions provided, the problems that arose during the work, as well as the students' subjective suggestions for optimizing the use of this method in

further education were analyzed. Most respondents, namely 54.8%, said that it took them 1-2 hours to create a mind map; 26.2% said 2-3 hours; 16.7% said more than 3 hours; and 2.4% said less than 1 hour.

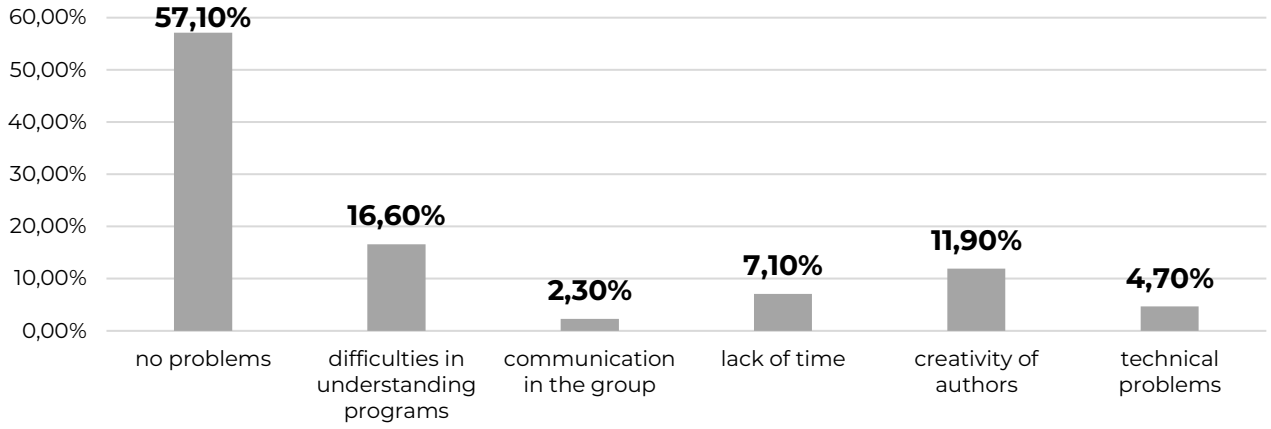
Regarding the instructions provided, on a scale of 1 to 5, where 1 is 'Not clear at all' and 5 is 'Completely clear,' 57.1% chose '5,' 35.7% chose '4,' and 7.1% chose '3.'

We believe this is due to the fact that the video instruction we provided was only for work on the Miro platform. Students chose other platforms and took a long time to understand their use. work.

The majority of respondents (57.1%) said they had no problems working with mind maps. 11.9% mentioned the creativity of the authors, which slowed down the process; 16.6% noted that they had certain difficulties in understanding the programmes; 7.1% mentioned lack of time; 4.7% mentioned technical problems, in particular problems with lighting; 2.3% mentioned problems with communication within the group (Fig. 3).

Figure 3

Difficulties encountered by students when creating a mind map



Among the most common suggestions for improving the use of mind maps, most students said they had no suggestions – 57.1%. Among the leading suggestions were: Use maps not only in medical biology, but also in other subjects' – 7.1%, 'Use them more often' – 24.4%, 'Use mind maps not only for preparation, but also for summarising and reviewing material' – 7.1%, 'Integrate maps into the learning process as an auxiliary tool' – 7.1%.

DISCUSSION

To complete the assignment, we offered students a choice of paper or digital platforms: Coogle, XMind, the cross-platform service Canva, or the interactive whiteboard Miro (Zuziak & Rabetska, 2025). Most students chose digital platforms over traditional paper media. Zainuddin et al. note that digital platforms allow students to focus on the content of learning and minimise the time spent on technical design, thus reducing cognitive load (Zainal Abidin et al., 2025). Suryani et al. (2024) confirm their colleagues' opinion, noting that the use of digital environments contributes to the development of students' digital competence and their greater involvement in the content of the work.

In our opinion, another reason for using digital platforms may be the convenient dynamic editing of material and the high level of digital literacy of today's youth. The choice of Canva as the preferred platform can be explained by its intuitive interface and the availability of ready-made templates, which also minimises cognitive load and the technical part of the work. Canva has an intuitive interface with drag-and-drop features

and professional templates, making it an accessible platform for high-quality design even without special skills (Pedroso et al., 2023). The results of a study by Anandha, R. P., et al. show that Canva improves engagement, comprehension, and cognitive development during lessons, leading to positive learning outcomes and serving as a digital tool for effective note-taking (Jamaludin & Sedek, 2024).

When working on the material, students noted that 'Key words' (59.5%) became a priority, which we associate with the specifics of preparing for the KROK exam. Students focus on terminological markers that are critical for solving test tasks. We did not find any information in the literature about the role of keywords in the training of medical students, but we assume that students view the mind map not as an illustration, but as a navigation scheme, where keywords serve as markers for quick identification of correct answers in KROK tests. The low importance rating of colour (9.5%) and the central image (11.9%) may indicate a purely pragmatic approach to learning on the part of future medical professionals.

We assume that the large amount of medical information forces students to perceive colour not as a stimulus for orientation, but as additional visual noise, especially in complex multi-component topics. Students identify the important role of 'Branches' and 'Arrows' in structuring and processing material. This is natural, as these components of the maps reflect the logical structure of the topic. However, when comparing these two concepts, the relatively low percentage of arrow usage (28.5%) compared to branches (40.5%) indicates that respondents prefer a hierarchical structuring of knowledge (Novak & Cañas, 2008).

A positive assessment in structuring the material and improving understanding of cause-and-effect relationships may indicate that the student is moving from passive reading to active use of knowledge. Recording what has been read in the form of a diagram with key words and their interrelationships highlighted forces the student to think and analyse the material (Kravets et al., 2025). It is particularly significant that 100% of respondents recognised the usefulness of maps in independent work with literature. This indicates the development of self-regulated learning skills, which are critical for the medical profession. In other words, students set specific goals for themselves, control the learning process, and adapt strategies to achieve better results (White et al., 2013).

The advantage of mind maps over traditional note-taking for 88.1% of respondents confirms the conclusions of Farrand et al. that non-linear visualisation is better suited to the memory architecture of future doctors. Their research reports that mind maps improve the actual memorisation of medical information by 10% compared to traditional learning methods (Farrand et al., 2002).

CONCLUSIONS

1. The introduction of mind maps into the medical biology teaching process has demonstrated high didactic value: 95.2% of students confirmed an improvement in the structuring of material, and 83.3% confirmed a deeper understanding of cause-and-effect relationships. This confirms that a non-linear form of presenting information is relevant for overcoming the barriers of 'clip thinking' among modern students.
2. The mind mapping technique has a significant advantage over traditional note-taking for 88.1% of respondents.

3. Digital platforms (92.9%) dominate over paper media, with Canva (50%) leading the way. This is due to the high level of digital literacy among students and the desire to minimise external cognitive load through intuitive interfaces and ready-made templates.
4. Analysis of the key elements of the cards revealed a specific 'medical' visualization profile: priority of keywords (59.5%) and branches (40.5%). This choice is due to the focus on preparing for the KROK exam, where keywords serve as terminological markers for quick identification of correct answers.
5. Despite the time spent (1–2 hours for 54.8% of respondents), students demonstrate high motivation for the method. The high demand for the integration of mind maps into the study of other disciplines emphasises the need to create unified methodological recommendations and multimedia instructions for various digital platforms in order to optimise the independent work of future specialists.

CONFLICT OF INTEREST

The authors declare that there are no conflicts of interest regarding the publication of this paper.

FUNDING

The authors declare that this study received no specific financial support.

ARTIFICIAL INTELLIGENCE STATEMENT

No artificial intelligence tools were used in the preparation of this manuscript.

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