

Implementation of Visual Mind Mapping Strategy for Improving Students' Performance

Oksana Tymofyeyeva^{1,*}, Nataliia Shulha², Viktoriia Savishchenko³, Halyna Klimova⁴ & Olena Bulavina⁵

¹Department of the Humanities, Danube Institute of National University "Odessa Maritime Academy", Izmail, Ukraine

²Department of Languages and Humanities, Donetsk National Medical University, Lyman, Ukraine

³Educational-and-Scientific Institute of Law and Innovative Studies, Dnipropetrovsk State University of Internal Affairs, Dnipro, Ukraine

⁴Department of Sociology and Political Science, Yaroslav Mudryi National Law University, Kharkiv, Ukraine

⁵Department of Pedagogy and Psychology, Personnel Management, Sociology and Psychology Faculty, Kyiv National Economic University named after Vadym Hetman, Kyiv, Ukraine

*Correspondence: Oksana Tymofyeyeva, Danube Institute of National University "Odessa Maritime Academy", 9, Fanagoryiska, Izmail 68607, Ukraine. Tel: 380-93-425-30-80. E-mail: education.now.2021@gmail.com

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Abstract

The aim of the article was to substantiate the implementation of the visual mind mapping (VMM) strategy for improving the effectiveness of students' learning in the theoretical and experimental aspect. The focus was the use of VMM to organize learning of students of non-Humanities majors when studying the subjects of the Humanities curriculum, which are mandatory for the undergraduate level. Methods: the following methods were used to collect empirical data and interpret research results: online monitoring through questionnaires in Google Forms; testing with the involvement of the computer programme potential using the EdApp microlearning platform tools; Computer-Assisted Personal Interviewing (CAPI), classic methods of conducting scientific research and statistical data processing. The prospects of further research include a wider integration of VMM with the involvement of special software and determining its impact on the effectiveness of the students' education.

Keywords: visual mind mapping (VMM), innovative education, non-Humanities majors, the Humanities, students' performance, cognitive processes, memorization

1. Introduction

1.1 Relevance

The focus of modern education is building an active and mutually interested learning environment. Besides, there is the issue of adapting the educational content to the needs of new generations. The matter is also about the peculiarities of the perception of educational material, which depends upon the peculiarities of cognitive processes inherent in an entire generation, and on the demands of the professional sphere of future specialists. Visual Mind Mapping (VMM) is a special technique, which is aimed at improving the learning of educational material through the active involvement of students in working on a visualized, personalized and partly creative data arrangement. VMM is an alternative to traditional reproductive methods of working on the assimilation of educational material, in particular, lecture notes, independent processing of large volumes of theoretical material with its subsequent arrangement in the form of a chart, where graphic connections explain logical and cause-and-effect relationships between flowchart elements. So, VMM is based upon the more familiar concept of block diagram representation. The fundamental difference is that the flowchart is clearly arranged and has a defined system of conventions. A VMM is an informal flowchart for representing tasks, marker words (keywords, ideas, semantic field), concepts, or related items and visually arranged around a central idea. Using a non-linear or radial graphic layout or building it independently, the student should create an intuitive structure around a central concept (for example, lesson topic,

subtopic, author, character or literary work, etc.). VMM transforms a routine collection of monotonous information into a colourful (it is appropriate to use different colours and shapes in the image), well-remembered and highly organized flowchart, which works according to the natural way the human brain works, taking into account both universal and individual cognitive features. VMMs are the most creative varieties of classic charts, flowcharts, where absolutely any symbols or shapes are acceptable, as long as they play the role of a semantically comprehensive and visually understandable symbol. VMMs are typically created by hand, as this is the easiest way of reproducing the brain function, monitoring the perception of the material, highlighting the dominants and arbitrarily arrange the material, regardless of the potential of special computer programmes, which usually have a number of limitations in this regard. Mind-mapping reflects non-linear thinking. Mind maps are organizers of the thinking process, which enable to arbitrarily visualize an idea and all the related connections.

1.2 Unexplored Issues

VMM is not a 21st century innovation. VMMs have the longest history of human use, bearing a resemblance to ancient petroglyphs. Nevertheless, modern education lacks practice of using the VMM method for students, especially in the humanities majors. According to the authors of the article, this is a significant shortcoming, while the stereotype about the incompatibility of flowcharts with the humanitarian educational paradigm is anachronistic. It is appropriate to use VMM for students of the humanities majors as innovative and relevant to the modern context of the era of the informational postmodern society when it comes to this method and the fundamental non-linearity of thinking and a creative approach to building mind map materials. The matter is about the ability to process large amounts of information and arrange it advantageously, interpret it in other ways of presentation.

1.3 Aim

The aim of the article is the theoretical and experimental substantiation of the effectiveness of the visual mind mapping (VMM) for improving performance of students of non-Humanities majors when studying the subjects of the Humanities curriculum, which are mandatory for the undergraduate level.

1.4 The Aim Involved the Following Research Objectives

- 1) carry out a theoretical and methodological analysis of the VMM method in the modern educational paradigm of high school;
- 2) identify the current place of VMM among the methods and technologies for organizing students' work in higher educational institutions (HEIs);
- 3) experimentally study the effectiveness of the implementation of VMM for students of the Humanities majors on the basis of comparing the results of the learning outcomes of students of the control and experimental groups;
- 4) generalize the results of empirical research, outline optimal ways of integrating VMM into the educational process in HEIs on a regular basis and in organic unity with other types of educational activities.

2. Literature Review

VMM is gaining popularity as a method and an integrated strategy of the educational process. The VMM is organically synthesized, complements the main directions of reforming the education in general and higher education in particular (Muhlisin, 2019; Utami & Subali, 2019; Filipova et al., 2020). VMM favourably interacts with the trends of individualization of education, active learning, integration of ICT in education, reformatting of the process of obtaining education in view of 'clip consciousness' and the need to process huge volumes of available information.

According to available findings of international studies, VMM stimulates the development of innovative thinking. The results showed that the teaching method which involves mind maps (for example, presentation of lecture material or the results of independent work) is more effective than traditional teaching methods (Bawaneh, 2019; Yang et al, 2022; Valyukevych et al., 2021). The lack of works dealing with the effectiveness of the mind maps for students of the Humanities majors was mentioned above. On the other hand, there are some academic findings proving that VMMs can be used with any type of material, which makes them a productive teaching tool for any university course (Muñoz González et al., 2014).

The VMM is a material representation of a radial (as opposed to a fixed) way of thinking, which is the most natural way of arranging thoughts (Dweck & Yeager, 2019). The VMM reflects the usual, typical brain functioning. The British psychologists Buzan and Buzan (1996) are the founder of VMM as a new type of thinking culture (Buzan &

Buzan, 1996; Buzan & Griffiths, 2013); he became famous thanks to VMM back in the 1970's. The mind map integrates the concepts of the entire brain, in other words, it involves absolutely all centres of both hemispheres. So, VMM is an illustrated reflective thinking tool.

In the philosophic aspect, VMM is based upon the constructivism ideas (Cendros Araujo & Gadanidis, 2020; Melrose, 2013) with the central pedagogical concept of instructional scaffolding. Pedagogical constructivism is focused on the aspiration to get to know students as individuals, to understand their unique ways of building thoughts, arranging and interpreting information on the way to its transformation into knowledge. A significant thesis is that mind maps are frameworks providing necessary support to students in their movement towards the independent purposeful creation of their own system of knowledge about the subject and the object they study (Melrose, 2013). The matter is obviously about mind maps with ready-made schemes which students have to finalize: fill in the gaps, establish the necessary connections, add, etc. This type of work with VMM is primary, and prepares students for independent building of VMM without any restrictive prototypes. These two types of maps are terminologically defined as construct-by-self mind mapping and construct-on-scaffold mind mapping (Zhao et al., 2022). Construct-by-self mind maps are maximally individualized, and therefore correspond to the idea of building one's own educational trajectory.

VMM is a fundamentally new way of monitoring knowledge and its subsequent assessment, which means a transition from traditional to alternative assessment methods (Ahmad et al., 2020). Besides, VMMs contribute to the improvement of learning motivation, in particular with the projection on lifelong learning, adjusts the brain to an optimal mode of functioning, which the authors describe as an increased brain's "desire" to acquire new knowledge (Liu et al., 2018; Tsybalenko, Tarasenko & Bielialov, 2019).

The methodological use of Mind Mapping as a assistive tool in corrective pedagogy under Learning Difference or Neurodiversity for overcoming difficulties in acquiring new knowledge and skills is important (Nitchot et al., 2019; Chiu & Lim, 2020).

3. Methods

3.1 Research Design

In the theoretical interpretation of VMM and in particulars of the methodological integration of VMM into the educational paradigm of students of HEIs, the authors of the article rely on the works of Buzan and Buzan (1996) and the Berg's (2016) book *Visual Leap: A Step-by-Step Guide to Visual Learning for Teachers and Students*, which is specially designed for teachers and students.

The first stage (March 2020 – June 2020) provided for a thorough study of the previous experience of using VMM, which was the basis for a literature review carried out for this study and developing a strategy for implementing VMM in teaching Humanities to students of the non-Humanities majors. But the changes were made to the almost ready strategy in April in accordance with the decision of the Cabinet of Ministers of Ukraine on the imposition of quarantine restrictions and the resolution of the Ministry of Education and Science on the transition to distance learning. During this time, the teachers who were planned to be involved in the empirical study participated in online training on the use of VMM. It was the Mind Mapping Mastery course from UdeMy and another course from MindMeister Academy.

The second stage (September 2020) involved online monitoring among students in order to assess their level of competence regarding mind maps and the frequency of VMM use by teachers. The obtained results of the monitoring among students — the extremely low level of integration of VMM into the educational process — revealed a need to change the primary project plan of the study and conduct monitoring also among teachers in order to find out the reasons why they use the VMM method extremely rarely. A sample was formed for control and experimental groups.

The third stage (October 2020 – December 2021) provided for the integration of the strategy of using VMM for teaching students of the experimental group. The students of the control group studied in a regular course with a predominance of traditional forms of distance and blended learning, study of lecture material, completion of assignments in practical and seminar classes, self-study. VMM was used sometimes for teaching in the control group. Special conditions for teaching, where lectures were not delivered for a stream, but separately for respondents of different groups, were created for this purpose. The same applies to other types of academic activity. The use of VMM was focused upon teaching students of the experimental group the philological and culturological subjects, which were provided by the approved educational and professional programmes of the universities involved in the experiment.

The fourth stage (end December 2021) involved final testing for both groups of respondents and self-reflection interviewing for students of the experimental group. The results were statistically processed during January and February, followed by the discussion at the meetings of the academic councils.

3.2 Sampling

The students from three higher educational institutions were involved in the experiment: Danube Institute of National University “Odesa Marine Academy”, the Educational and Research Institute of Law and Innovative Education of Dnipropetrovsk State University of Internal Affairs, Donetsk National Medical University. The sample was random consisting of students of the 1st-2nd years of study, with an approximately equal number of participants from each HEI. Table 1 presents the final composition of the sample.

Table 1. Sample of Research Participants

	Control group	Experimental group
Danube Institute of National University “Odesa Marine Academy”	56	49
The Educational and Research Institute of Law and Innovative Education of Dnipropetrovsk State University of Internal Affairs	27	36
Donetsk National Medical University	42	45
Total	125	130

An agreement was signed with all participants on the legal and ethical aspects of using their personal data and publication of the results of the study, which provided ethical guarantees.

3.3 Methods

Questionnaires in Google Forms were used for online monitoring at the second stage of the study. The questions related to their knowledge of the essence of VMM (open-ended question), the individual level of VMM use for household and educational (separately) needs, as well as the level of VMM use in a previous educational institution and the level of VMM use in the university (as a percentage: from 0 to 100%). A total of 587 students (bachelor’s and master’s degrees, interns) from three educational institutions of all majors were involved in the survey. Later, they took an active part in the preparation and implementation of the experiment. We emphasize that the sample of respondents involved in monitoring do not coincide with the sample of participants of the subsequent experimental study. The aim of the monitoring was finding out the general level of the current integration of VMM into education in universities. Monitoring among teachers was organized according to a similar plan. It involved 128 teachers. Testing was voluntary for students and mandatory for teachers who received online questionnaires in Google Forms.

VMMs were used according to templates charts (approximately in 25% of all cases of use, mostly at the initial stages of the experiment) and arbitrarily, handwritten by the students according to their own mental charts of perception and visualized interpretation of the processed information. Templates were offered both designed and printed by teachers in advance (for example, to arrange lecture material), and interactive online maps using available Internet platforms such as Mind Meister (Mind Map & Brainstorm Online) and Canva (Free Mind Map Maker & Editable Mind map examples).

At the fourth stage, the method of computer automated testing was applied in order to assess the level of hard skills on the subjects covered by the experiment (these are the mandatory subjects for the undergraduate level —Bachelor’s degree, such as: 1) Foreign Language; 2) Foreign Language for Professional Purposes; 3) History of Ukraine and Ukrainian Culture; 4) Philosophy; 5) Ukrainian Language (for Professional Purposes). The test contained a total of 30 questions from each subject (30*6). There were a total of 150 questions (1 question = 1 point). The test took 2 hours and 30 minutes. The testing was conducted at different times because of the large number of respondents. The test was prepared by a team of teachers from three universities and implemented in the computer programme using the EdApp microlearning platform toolkit. The final results (number and percentage of scored points) appeared on the screen immediately after pressing the button “Submit all and complete the test”, without the possibility to view the result for each individual question. This option was intentional with a purpose of preventing possible disclosure of the questions to other respondents who have not taken the test.

Computer testing was followed by the Computer-Assisted Personal Interviewing (CAPI) conducted individually with participants of the experimental group. It was aimed at getting feedback from students. They were asked to express themselves on a series of questions related to their personal experience of using VMM during the experiment (short essay, open-ended questions such as “continue the sentence”, “make an opinion”, “justify”, “compare”, etc.). It was

followed by a collective discussion of the effectiveness of VMM in stimulating their soft & hard skills, increasing learning motivation. Difficulties encountered during the work were identified and prospects for improvement of the VMM implementation programme as a university strategy optimal for the 21st century were outlined.

3.4 Results

3.4.1 Online Monitoring Results

Table 2 presents the results of online monitoring conducted at the first stage of the study.

Table 2. Monitoring of Students for Identifying the Level of the Use of VMM Potential among Other Teaching and Learning Methods in HEIs

	Danube Institute of National University “Odesa Marine Academy”	The Educational and Research Institute of Law and Innovative Education of Dnipropetrovsk State University of Internal Affairs	Donetsk National Medical University	Average
Number of involved students	197	173	217	
The level of VMM use in the previous educational institution (school, college, other educational institutions)	4.5%	3.1%	2.2%	3.4%
The level of VMM use in university education	6.1%	4.2%	4.7%	5.0%

Despite all the subjectivity of such monitoring and the possible error in the accuracy of the data provided by the respondents, the contrasting of the level of VMM use in universities showed quite insignificant growth — only 1.6%. Such results indicate: 1) a critically low level of VMM implementation in the entire system of education; 2) insufficient use of VMM potential for students of HEIs as a key stage of professional and personal development; 3) the difference between the level of VMM use depending on the educational institution is not crucial, which indicates that VMM is not popular in the modern education system of Ukraine; 4) confirms the relevance of the problem and urges the need for research into the potential of VMM and the development of integrated strategies for the use of VMM synthesized with other types of educational activities. As a result, students are potentially not ready to operate with large volumes of information in the modern world. And it also illustrates the unrealized students’ thinking potential, as VMM itself, as noted in the literature review, is a unique method of activating cognitive processes in all sections of the brain. The students were asked an open-ended question about the understanding of the VMM content: it partially legitimizes the monitoring results, makes them reliable. The respondents showed an understanding of the basic features of VMM as a method, albeit with varying degrees of comprehensiveness. This indicates that, when answering the following questions of the questionnaire, the monitoring participants had a clear idea of the subject of the study, therefore, they answered mostly correctly. The approximate number of respondents who did not know the essence of VMM as an educational method was only 2-3%, which cannot significantly affect the general conclusions. It is important that as many as 49.8% of respondents answered that they had never worked with the VMM method before, although they had previously dealt with educational flowcharts, which are a prototype of VMM.

As stated in the Materials and Methods paragraph, a need to change the original plan and conduct the monitoring among teachers was found in the course of the implementation of the primary research project. The questionnaires for teachers did not include a question about the percentage of VMM involvement in individual teaching techniques because of the problematic nature of the VMM issue itself and in order to avoid falsely exaggerated data on the part of teachers regarding the level of their integration of VMM into the educational process. The teachers were offered answer options. The teachers could choose all the options they considered necessary. In other words, in order to find out the most comprehensive range of restraining factors for the full use of VMM, the monitoring organizers did not limit teachers to the number of possible options. Table 3 presents the results of monitoring among teachers.

Table 3. Teachers’ Monitoring for Identifying the Level of Use of VMM Potential among Other Teaching Methods Applied in HEIs

	Danube Institute of National University “Odesa Marine Academy”	The Educational and Research Institute of Law and Innovative Education of Dnipropetrovsk State University of Internal Affairs	Donetsk National Medical University	Average
The number of teachers involved	39	33	56	
The reason for the low level of integration of VMM into the educational process, % of positive answers from the group of respondents				
1. Lack of data on the method of using VMM	78.2%	65.4%	89.1%	77.6%
2. Personal reluctance to use VMM	22.4%	35.8%	41.3%	33.2%
3. Distrust in the educational potential of VMM	39.8%	29.2%	48.1%	39.0%
4. Lack of special training in VMM application techniques for educational purposes	87.2%	76.9%	91.5%	85.2%
5. Reluctance to change traditional teaching techniques developed over years	69.3%	58.6%	71.2%	66.4%
6. Lack of control by the administration of HEIs over the use of innovative teaching techniques	14.2%	10.3%	19.4%	14.6%
7. Difficulties in using VMM by students	38.7%	29.8%	31.5%	33.3%

Figure 1 presents the ranking of restraining factors listed in Table 3.

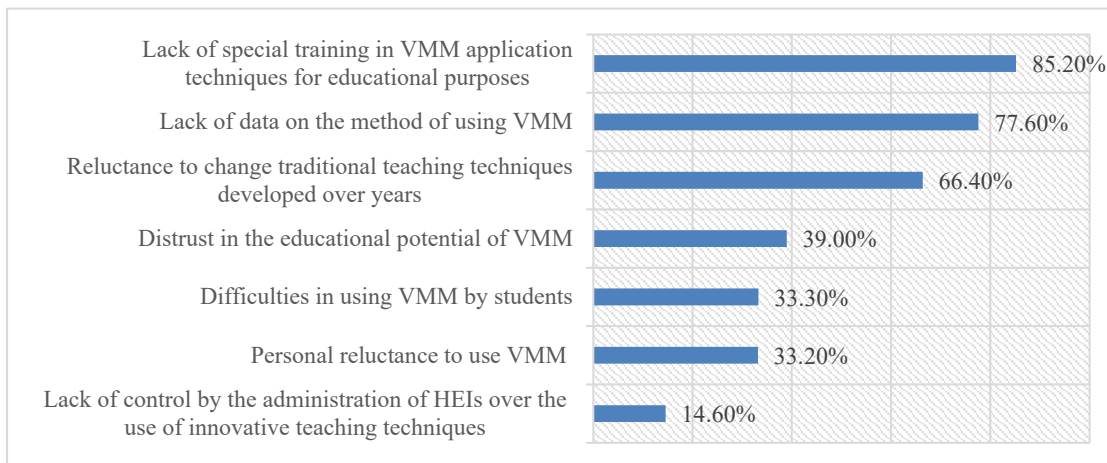


Figure 1. Ranking of Restraining Factors for the Full Use of VMM as a Teaching Method and Strategy in HEIs (according to the results of monitoring among teachers)

According to the monitoring, the lack of special training in the application of VMM for educational purposes is the main reason for insufficient integration of VMM into the educational process in universities (85.2%). In contrast, the teachers’ reluctance to reform established teaching methods play a major role, which is a serious problem associated with insufficient stimulation of the professional self-development of teaching staff. In particular, the reason is the lack of events organized by the administrations of HEIs, which would contribute to the innovations in teaching in order to keep up with the times and to meet the needs of new generations of students. It should be noted that teachers in the over 40 year age group chose this answer. As regards fear of the expected difficulties in using VMM by

students, the authors of the article believe that this item is related to the leading item in the ranking: the lack of methodological skills entails difficulties in conveying all the advantages of using VMM to students.

3.4.2 Final Results of the Experiment

The VMM method was intensively involved in teaching students of the experimental group during 1 year and 2 months. Table 4 provides the results of final testing of respondents from the experimental group in comparison with the results of similar testing among respondents of the control group.

Table 4. Comparative Table of the Results of the Experiment According to the Final Testing

Academic subject (max 30 points each)	Control group	Experimental group
	The average number of points scored	
1 Foreign Language	16	21
2 Foreign Language for Professional Purposes	18	26
3 History of Ukraine and Ukrainian Culture	19	22
4 Philosophy	21	25
5 Ukrainian Language (for Professional Purposes)	23	27
Average per subject	19.4	24.2
The average value of the number of points for the test (max 150)	97	121

The percentage of performance by groups was calculated according to the formula $\frac{\text{Points scored by the group}}{x\%} =$

$\frac{150 \text{ points}}{100\%}$. The result of the calculation is presented in Figure 2.

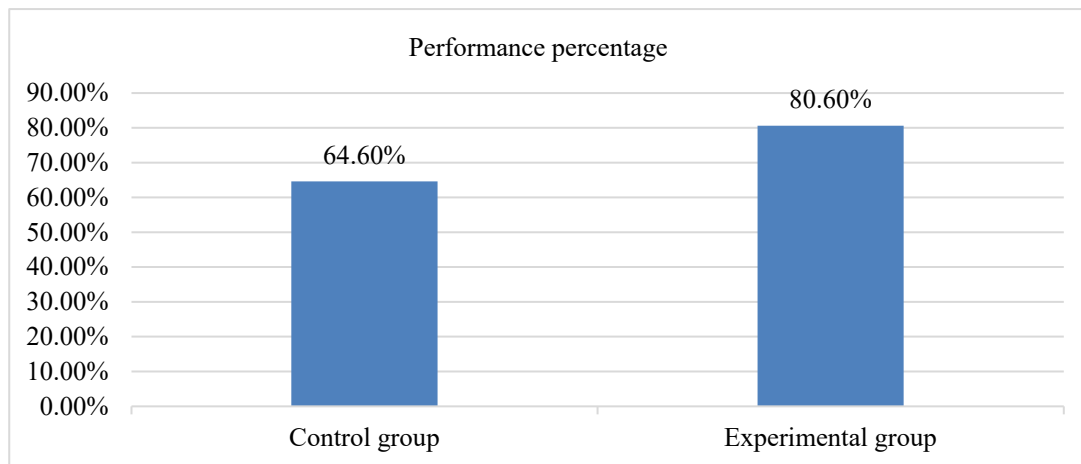


Figure 2. Percentage of Performance by Groups According to the Results of the Final Test

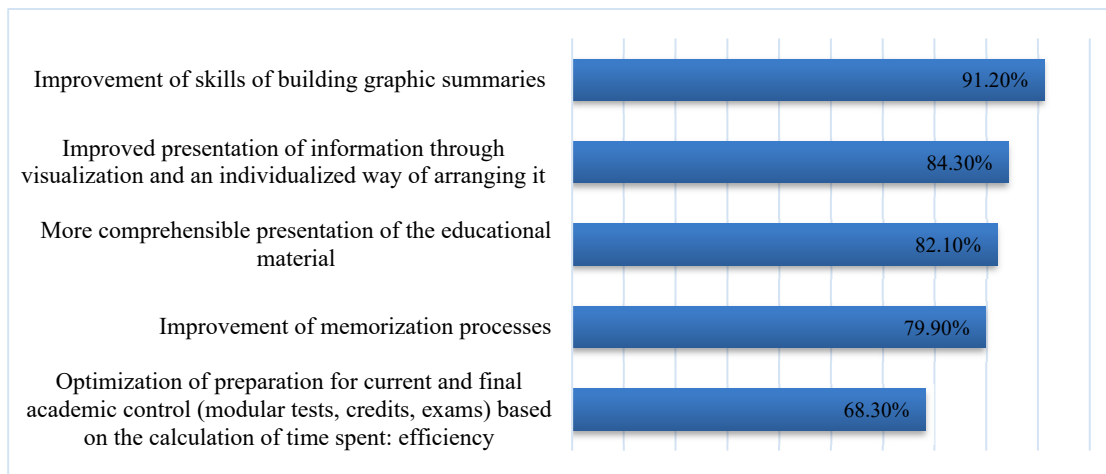
So, the final result of the experiment on the intensified use of VMM in teaching of the Humanities to students of non-Humanities majors is that the participants of the experimental group are ahead of the participants of the control group by 16%.

Table 5 also presents the results of a qualitative analysis of Computer-Assisted Personal Interviewing (CAPI) data, which was conducted among students of the experimental group. The student could choose as many options as he/she considered necessary, or choose none if he/she did not see a positive impact of the VMM on his/her educational activities.

Table 5. Table of Evaluation of the Impact of VMM on Learning Outcomes

	The area of impact of VMM on learning outcomes	% of positive answers
1	More comprehensible presentation of the educational material	82.1%
2	Improved presentation of information through visualization and an individualized way of arranging it	84.3%
3	Faster preparation for practical classes, seminars	34.7%
4	Optimization of preparation for current and final academic control (modular tests, credits, exams) based upon the calculation of time spent: efficiency	68.3%
5	Improvement of memorization processes	79.9%
6	Improvement of skills of building graphic summaries	91.2%
7	Improvement of interaction with ICT for educational purposes	34.1%
8	Increase in the learning motivation	21.8%
9	Stimulation of a creative approach to learning	29.7%
10	Encouragement of research work	41.5%

Figure 3 presents the ranking of the five areas of improvement, which the students assigned the highest percentage. They can be interpreted as strategic when using the VMM method in relation to the facilitating, as well as stimulating and optimizing function of the VMM.

**Figure 3.** Top-5 Areas of Positive Impact of VMM on the Learning Outcomes of Students of the Experimental Group According to CAPI Results

The item “Faster preparation for practical classes, seminars” was rated the lowest. We consider it natural, as the interpretation of information in the VMM format is a labour-intensive process and requires considerable time, especially at the first stages of working with VMM. Nevertheless, this shortcoming is compensated by improvements in other areas, which characterize the educational activity of a high school student.

4. Discussion

The obtained results of teaching the Humanities to students of non-Humanities majors using VMM generally correspond to the data on increased effectiveness of educational activities with the involvement of the VMM method, which were presented in earlier studies. For example, an experimental study by Johns Hopkins University conducted in 2008 demonstrates a 12% improvement in students’ grades (academic performance) (Boley, 2008). The results of the study carried out by Petro (2010) showed a slightly lower result: according to the author, mind mapping increases the learning and maintenance of information by 10%, provided that it was used methodologically correctly in the educational activities of students of HEIs. The final result of the experimental study presented in this article shows a 16.0% increase in students’ performance in the experimental group compared to students in the control group, where there was no intensive use of VMM.

We agree with the opinion of researchers who explain the improvement in students' academic performance through the use of VMM by the fact that VMM helps to arrange ideas and better understand concepts of the educational material (Melrose, 2013; Muhlisin, 2019). This not only optimizes the entire process of assimilation of new information — its transformation into knowledge, but also more effectively embeds new information into long-term memory (Melrose, 2013; Yang et al., 2022; Bawaneh, 2019). Adding colours and images to mind maps makes VMM a much more efficient way of working than classic flowcharts (Sentyawati, 2022; Agustina et al., 2018; Al Shdaifat et al., 2019).

The following types of educational activity are particularly fruitful and favourable for the use of VMM during students' educational activities: note-taking-brainstorming (individually or in groups); problem solving; studying and memorizing new material; planning; gathering and summarizing information from many sources; schematized and semantically comprehensive, visually reasonable presentation of information; studying complex topics; development of a creative approach to learning, etc. (Boley, 2008; Nitchot et al., 2019).

The monitoring conducted at the first stage of the study among students showed a rather alarming trend of neglecting the potential of VMM and a generally low interest of the teachers themselves in making their teaching more innovative (Khandelwal et al., 2022). Nevertheless, monitoring among teachers provided the key to understanding the problem and solving it. The underlying reason is overcoming the lack of special training on the methodology of using VMM for educational purposes and getting out of the information vacuum regarding the integration of VMM into the educational process in high school. An effective way of overcoming this state of affairs is institutionally encouraged special training of teachers, improvement of their qualifications regarding the latest teaching methods, including VMM, which shall be methodologically provided by the administration of HEIs. The results of the final test in the experimental group and the data obtained from testing by the CAPI method proved the effectiveness of this algorithm.

The authors of the article also insist on the advantages of using mind maps as opposed to concept maps for the study of the Humanities, especially the philological and culturological subjects (Melrose, 2013; Eppler, 2006; Muhlisin, 2019). Mind maps are less bound by formalized rules and can be created spontaneously, synchronously with the course of cognitive activity — simply during the initial perception of information (Stepanenko et al., 2021). In contrast, concept maps are more abstract, require careful consideration, and may take longer to construct because the process of establishing strict hierarchical relationships between components requires a deeper and more systematic understanding (Melrose, 2013). Similar to other studies on the specifics of using VMM for student learning, the authors of this study debunk the stereotype of the lesser potential of VMM for teaching the Humanities (Yee Tay & Li Phang, 2022; Orozco-Messana & Martinez-Rubio, 2021).

5. Conclusions

5.1 Relevance

A conclusion was made in this article about the relevance of VMM to the current educational paradigm, the subjects of the educational process and the peculiarities of professional activity in the 21st century even before the empirical study on the basis of the multiple characteristics of VMM as an educational method and the literature review. The results of the study, namely the monitoring of students and the subsequent experimental comparative study among the students, confirmed the thesis about the relevance of the VMM discourse in higher school pedagogy.

5.2 Conclusions Based upon the Obtained Results

The results of monitoring among students revealed a very low level of use of the VMM method for organizing students' educational activities. This is an average of 5.0% only, which is only 1.6% higher than the level of VMM use in the students' previous educational institutions, which are mostly secondary schools. Nevertheless, the level of university education is undoubtedly more favourable for the intensive integration of the VMM method into the educational environment. An important conclusion is the result of monitoring among teachers of HEIs. It shows that the lack of special training on using VMM for educational purposes (85.2%) and the general lack of data on using VMM (77.6%) are the main restraining factors that prevent the use of VMM at the level of teaching strategy.

The special training of the teachers who participated in the experiment compensated for the outlined problems and helped to achieve a qualitative improvement in the success of learning the educational material by the students of the experimental group by 16% better compared to the respondents of the control group with traditionally low integration of VMM: 64.6% was the qualitative success rate among the students of the control group against 80.6% demonstrated at the stage of final testing of the experimental group. An important finding is breaking of stereotypes

about the VMM method as more suitable for teaching non-Humanities. Computer-Assisted Personal Interviewing (CAPI) among students of the experimental group showed an unambiguously positive effect of VMM on the course of educational activity. The greatest improvement was recorded for “Improvement of skills of building graphic summaries” (91.2% of respondents gave a positive answer), “Improved presentation of information through visualization and an individualized way of arranging it” (84.3%), More comprehensible presentation of the educational material (82.1%). Nevertheless, we consider the positive impact on memorization processes, improvement of memorization processes at the level of long-term memory to be one of the most important achievements.

5.3 Applications

The results of the presented experiment can be used for developing mechanisms for implementing VMM in the educational environment of a higher school in order to improve the effectiveness of students’ learning. The research model can be used in its original or adapted form for the preparation of similar studies. The results of this survey are an important contribution to the development of a comprehensive strategy for updating the educational process in HEIs in order to optimize it and bring it in line with the current realities and challenges.

5.4 Prospects of Further Research

This study focused on the predominant use of student-created visual maps as VMM. This research can be further developed to involve Mind Mapping software, which integrates with MS Office and Google, enabling students to convert their ideas into other documents such as Word or PowerPoint.

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