ФІЗИКО-МАТЕМАТИЧНА ОСВІТА
(PHYSICAL AND MATHEMATICAL EDUCATION)
p-ISSN: 2413-1571, e-ISSN: 2413-158X 2025, 40(4), https://doi.org/10.31110/fmo2025.v40i4-08
UDC: 372.851

ОРГАНІЗАЦІЯ ПОВТОРЕННЯ ТА СИСТЕМАТИЗАЦІЇ ШКІЛЬНОГО КУРСУ МАТЕМАТИКИ В УКРАЇНСЬКІЙ ПРОФІЛЬНІЙ СТАРШІЙ ШКОЛІ

Юлія ТИХОНЕНКО ✉
Український державний університет імені Михайла Драгоманова, Україна
yu.v.tykhonenko@npu.edu.ua
https://orcid.org/0000-0002-7003-6266

Олександр ШКОЛЬНИЙ
Український державний університет імені Михайла Драгоманова, Україна
o.v.shkolnyi@udu.edu.ua
https://orcid.org/0000-0002-3131-1915

АНОТАЦІЯ

Формулювання проблеми. *У статті порушено проблему невідповідності між наявними державними щодо підсумкового повторення і систематизації шкільного курсу математики в умовах компетентнісного підходу з одного боку та його практичною реалізацією за чинними програмами та підручниками для старших класів з іншого. З урахуванням когнітивних теорій розвитку пам'яті та викликів під час підсумкового тестування старшокласників з математики, обґрунтовано актуальність дослідження ефективних підходів до повторення навчального матеріалу, які б сприяли зниженню навчальних втрат і належному формуванню математичної компетентності та інших компетентностей згідно з концепцією Нової української школи (НУШ).*

Матеріали і методи. *Було використано теоретичний аналіз методичної літератури, порівняльний аналіз, систематизацію та узагальнення наявних теоретичних досліджень з тематики статті, а також педагогічне спостереження та узагальнення власного педагогічного досвіду щодо повторення та систематизації шкільного курсу математики.*

Результати. *У результаті аналізу чинних підручників та збірників для підготовки до зовнішнього незалежного оцінювання (ЗНО) у формі національного мультипредметного тесту (НМТ) з математики виявлено різноманіття підходів до реалізації поточного й підсумкового повторення. З'ясовано, що підручники відрізняються за наявністю, структурою та змістовим наповненням рубрик для повторення, а теоретичні матеріали для систематизації знань практично відсутні. Навчальні посібники, зокрема, комплексні видання для підготовки до ЗНО (НМТ), частково компенсують ці прогалини, проте не забезпечують достатньої диференціації й потребують активної участі вчителя у процесі добору матеріалу для забезпечення належної якості підсумкового повторення.*

Висновки. *Встановлено, що наявні підручники та посібники з математики лише частково забезпечують умови для якісного підсумкового повторення, не охоплюючи потреб диференціації та зворотного зв'язку. Ефективність цього етапу навчання значною мірою залежить від професійної майстерності вчителя та здатності*

ORGANIZATION OF REPETITION AND SYSTEMATIZATION OF THE SCHOOL MATHEMATICS COURSE IN A UKRAINIAN UPPER SECONDARY PROFILE SCHOOL

Yuliia TYKHONENKO ✉
Dragomanov Ukrainian State University, Ukraine
yu.v.tykhonenko@npu.edu.ua
https://orcid.org/0000-0002-7003-6266

Oleksandr SHKOLNYI
Dragomanov Ukrainian State University, Ukraine
o.v.shkolnyi@udu.edu.ua
https://orcid.org/0000-0002-3131-1915

ABSTRACT

Formulation of the problem. *The article raises the problem of inconsistency between the existing state regulations on the final repetition and systematization of the school mathematics course in the context of a competency-based approach on the one hand and its practical implementation according to the current programs and textbooks for senior grades on the other. Taking into account cognitive theories of memory development and challenges during the final testing of senior students in mathematics, the relevance of researching effective approaches to the repetition of educational material, which would contribute to the reduction of educational losses and the proper formation of mathematical competence and other competencies in accordance with the concept of the New Ukrainian School (NUS), is substantiated.*

Materials and methods. *Theoretical analysis of methodological literature, comparative analysis, systematization, and generalization of existing theoretical research on the topic of the article, as well as pedagogical observation and generalization of one's own pedagogical experience in repeating and systematizing the school mathematics course, were used.*

Results. *As a result of the analysis of current textbooks and collections for preparation for external independent assessment (EIA) in the form of a national multi-subject test (NMT) in mathematics, a variety of approaches to the implementation of current and final repetition were revealed. It was found that textbooks differ in the presence, structure, and content of review rubrics, and theoretical materials for systematizing knowledge are practically absent. Textbooks, in particular, comprehensive publications for preparation for EIA (NMT), partially compensate for these gaps, but do not provide sufficient differentiation and require the active participation of the teacher in the process of selecting material to ensure the proper quality of final repetition.*

Conclusions. *It has been established that the existing textbooks and manuals on mathematics only partially provide the conditions for high-quality summative repetition, not covering the need for differentiation and feedback. The effectiveness of this stage of learning largely depends on the professional skills of the teacher and the ability to combine different sources and approaches. The development of adaptive repetition technologies using digital tools has been identified as a promising direction.*

© The Author(s) 2025

поєднувати різні джерела й підходи. Перспективним напрямом визначено розробку адаптивних технологій повторення з використанням цифрових засобів.

КЛЮЧОВІ СЛОВА: *Нова українська школа; повторення та систематизація; шкільний курс математики; підручник з математики; державна підсумкова атестація; зовнішнє незалежне оцінювання; національний мультипредметний тест.*

ДЛЯ ЦИТУВАННЯ: Tykhonenko Yu., Shkolnyi O. Organization of repetition and systematization of the school mathematics course in a Ukrainian upper secondary profile school. *Фізико-математична освіта*, 2025. Том 40. № 4. С. 52-58. https://doi.org/10.31110/fmo2025.v40i4-08.

KEYWORDS: *New Ukrainian School; repetition and systematization; school mathematics course; mathematics textbooks; state final attestation; external independent assessment; national multi-subject test.*

FOR CITATION: Tykhonenko, Yu., & Shkolnyi, O. (2025). Organization of repetition and systematization of the school mathematics course in a Ukrainian upper secondary profile school. *Physical and Mathematical Education*, *40*(4), 52-58. https://doi.org/10.31110/fmo2025.v40i4-08.

INTRODUCTION

The problem statement. Learning mathematics is a complex cognitive process, among the key functions of which is memory, which ensures the accumulation, preservation, and reproduction of educational information. In the process of learning, different types of memory are actualized: sensory, short-term (working), and long-term, the interaction of which ensures the formation of stable knowledge and skills (Baddeley, 2000). Accordingly, effective learning is not only about how to learn but also about how to promote the consolidation of knowledge and minimize the process of forgetting and loss of skills and abilities.

One of the central theories explaining the phenomenon of the decrease in the volume of learned material over time is the forgetting curve proposed by G. Ebbinghaus (Ebbinghaus, 1885). According to these studies, a significant part of the information is lost within a few hours of learning if strategies for its consolidation are not used. From the point of view of cognitive psychology, repetition is considered a key mechanism for consolidating information in long-term memory. At the same time, the effectiveness of repetition increases significantly when using distributed (interval) repetition (Cepeda et al., 2006; Kang, 2016), which allows for strengthening memory traces and preventing rapid forgetting. In addition, the systematization of knowledge contributes to the formation of cognitive schemes that provide a deeper understanding of inter-subject relationships and simplify the reproduction of information (Sweller et al., 2011). In the context of mathematics education, systematic generalization of material allows students to form stable neural connections and increases the level of mathematical competence. In turn, the competency-based approach is a cross-cutting line of the key reform of the Ministry of Education and Science of Ukraine - the New Ukrainian School (NUS). According to the NUS concept, competence is a dynamic combination of knowledge, skills, abilities, ways of thinking, attitudes, values, and other personal qualities that determine a person's ability to successfully socialize, engage in professional and/or further educational activities (Verkhovna Rada of Ukraine, 2017).

Mathematics occupies a significant place in the main regulatory documents on education (Verkhovna Rada of Ukraine, 2017; Cabinet of Ministers of Ukraine, 2020; Cabinet of Ministers of Ukraine, 2024), in particular, mathematics is a mandatory subject of external independent assessment (EIA) in the form of a national multi-subject test (NMT), the results of which are used for competitive selection to higher education institutions. This confirms the importance of forming the mathematical competence of school graduates as a necessary component of the formation of further professional skills. In this context, an important stage of the comprehensive study of mathematics is the repetition and systematization of both individual sections and the entire school course, since topics are included in the EIA (NMT) program in mathematics starting from the fifth grade (MES of Ukraine, 2019). However, the method of implementing the final repetition of the school mathematics course is not strictly regulated by state regulatory documents and therefore is carried out mainly at the discretion of the teacher within the limits of his professional competence in accordance with the content of the educational program, taking into account the EIA program in mathematics.

However, preparation for testing is not the responsibility of general secondary education institutions (GSEI). Therefore, it is quite difficult to determine whether the systematization and repetition of the mathematics course in GSEI is effectively implemented, because even the EIA (NMT) indicators in mathematics are often not only the result of students' educational activities within the school but also self-education, preparation with a tutor, or on courses, etc.

The development of the practice of preparing for the EIA (NMT) with a tutor or in courses may indicate both a high awareness of graduates and their parents about the importance of mathematical knowledge and skills, and an insufficient level of implementation of the final review in the secondary education system. The second option may be due, in particular, to the lack of time for implementing the final review during the educational process. The current mathematics curriculum for students in grades 10-11 does not provide for a separate time allocated for the final review, and its regulation can be carried out, for example, at the expense of part of the reserved time (MES of Ukraine, 2017).

Thus, we see a discrepancy between the state's request for systematized knowledge and skills (competencies) of graduates for the school mathematics course and the definition of the place of final repetition and means of its implementation in regulatory documents. Therefore, there is a need to study and compare existing approaches to the repetition and systematization of the school mathematics course, which can be implemented in the GSEI, as well as to identify the possibility of their combination, improvement, and development.

The analysis of current research. Repetition and systematization are important components of teaching mathematics as part of the educational process. In accordance with the Law of Ukraine "On Education" and the provisions of the concept of the New Ukrainian School, the educational process in the field of complete general secondary education is organized on the basis of a competency-based approach (Verkhovna Rada of Ukraine, 2017; MES of Ukraine, 2016). Even before the official introduction of the competency-based paradigm into Ukrainian education (NUS), this approach was highlighted in the works of S. A. Rakov, according to which: "Mathematical competence is not just mastering the content of the academic discipline, but the readiness

to apply the acquired knowledge and skills in various areas of activity, which requires the integration of subject, operational and reflective components" (Rakov, 2005).

To analyze the components of the educational and training process, in particular repetition and systematization in teaching mathematics, it would be appropriate to refer to the Standards of Education and Model Programs of the National State Educational Service. However, although the State Standard of Specialized Secondary Education has been adopted, which regulates the educational process in senior grades, it will come into effect only in September 2027. Therefore, currently, senior students study according to the State Standard of Basic and Complete General Secondary Education, approved in 2011 (Cabinet of Ministers of Ukraine, 2011), and the corresponding educational programs.

Approaches to systematizing knowledge in mathematics and implementing final revision can be traced to the location of relevant materials in mathematics textbooks for senior grades and in collections for preparing for the EIA in mathematics, the analysis of which is given in the main part of this work. The need to analyze these tools, find new approaches, or adjust existing ones is dictated by the results of the mathematics tests at the EIA in 2023 and 2024. The official report on the EIA in 2023 notes that the statistical indicators of the EIA tasks have deteriorated compared to the corresponding indicators of the EIA tasks of previous years, in particular, in tasks on the properties of functions, financial literacy, and stereometry (UCEQA, 2023). Also, in the mathematics test, tasks to check the level of formation of basic skills and abilities and their application in standard situations make up about 60% of the total number of tasks and, according to the results of the test in 2024, cause difficulties for test participants. A low level of development of skills and abilities was demonstrated by participants from the content line "Functions", theoretical tasks on planimetry also turned out to be difficult (UCEQA, 2024).

The purposes of the article are to compare approaches to the revision and systematization of the school mathematics course reflected in current textbooks and collections for preparation for the EIA (NMT) and, based on this comparison, to suggest ways to improve them.

METHODS OF THE RESEARCH

To achieve the goals of the study, we use a theoretical analysis of methodological literature related to the chosen topic, in particular, current programs and textbooks on mathematics for senior grades. We also apply empirical methods: observation of the educational process in GSEI and analysis of the achievements of students in mathematics in these institutions. In this article, we operate with different methods of scientific knowledge: comparative analysis to clarify different points of view on the problem; systematization and generalization to formulate conclusions and recommendations for organizing the repetition and systematization of the school mathematics course; we also summarize our own pedagogical experience and observations of other specialists on the process of teaching mathematics in Ukrainian schools.

RESULTS OF RESEARCH

In the mathematics educational program for students in grades 10-11, the repetition and systematization of knowledge and skills take a different place depending on the level at which students study this subject. The topic of generalization and systematization is separately presented only for the profile level in the course of algebra and the beginnings of analysis, and concerns the content line "Equations, inequalities and their systems". For the remaining topics in profile classes and classes of the standard level, repetition and systematization are not highlighted, but can be implemented at the expense of part of the reserve time, the approximate distribution of which is given in Table 1.

The proportion of reserved time for repeating and systematizing knowledge and skills in mathematics for a high school course depends on the characteristics of the cognitive abilities of students in a particular class or group, the organization of the educational process, educational losses and gaps, opportunities, and methods for overcoming them.

Table 1. Time to review and systematize the knowledge of mathematics in upper secondary school

		Algebra	Geometry
10th grade	Standard level	Reserve: 7 hours	Reserve: 7 hours
	Profile level (in-depth study from grade 8)	Reserve: 22 hours	Reserve: 18 hours
	Profile level	Reserve: 24 hours	Reserve: 18 hours
11th grade	Standard level	Reserve: 18 hours	Reserve: 14 hours
	Profile level (in-depth study from grade 8)	Reserve: 74 hours	Reserve: 28 hours
	Profile level	Reserve: 80 hours +30 hours on the topic: "Equations, inequalities and their systems. Generalization and systematization."	Reserve: 28 hours

Source: Own work.

Considering the means of repetition and systematization, we will divide them into organizational and content. Organizational means of repetition include diagnostic work, online testing, including in a game format, mathematical dictations, frontal questioning, and collective or independent problem-solving. In this article, we will focus on content means of repetition, which include textbooks, collections of tasks from educational and methodological sets for studying mathematics (algebra, algebra and the beginnings of analysis, geometry), collections of tasks for the state final attestation (SFA) in mathematics, manuals

for preparing for the EIA examination (NMT) in mathematics, tasks for the external examination options in mathematics, author's developments of complex or thematic tests in the format of the external examination in mathematics, educational videos, summaries, flowcharts and other reference materials.

The main means of learning in secondary education institutions remains the textbook, and therefore it is logical to first investigate the approaches to revision proposed by the authors of current mathematics textbooks (algebra and principles of analysis, geometry) for grades 10 and 11.

Having analyzed the textbooks on mathematics (standard level), algebra and beginnings of analysis, geometry (profile level) for grades 10 and 11, we identified the following variants of review rubrics: tasks for preparing to study a new topic, questions for self-control at the end of a paragraph or point on studying a new topic; tasks for reviewing previously studied topics; test tasks at the end of studying a section; tasks for reviewing the course of algebra and beginnings of analysis and the course of geometry for grade 10 or the entire course of mathematics for grade 11. Table 2 provides information on the corresponding rubrics in mathematics textbooks (standard level) by various authors.

Table 2. Repetition in mathematics textbooks for grades 10 and 11 (standard level)

Textbook author(s)	G. Bevs, V. Bevs		M. Burda, T. Kolesnyk, Yu. Maliovanyi, N. Tarasenkova	O. Ister		A. Merzliak, D. Nomirovskyi, V. Polonskyi, M. Yakir		Ye. Nelin	
Grade	10	11	10	10	11	10	11	10	11
Tasks to prepare for studying a new topic	–	–	–	+	+	+	+	–	–
Questions for self-control	+	+	+	+	+	+	+	+	+
Review previously studied topics tasks	+	+	–	–	–	+	+	–	–
Generalization of the theory to the section	+	+	–	–	–	+	+	+	+
Final test for the section	+	+	+	–	+	–	+	–	+
Final review at the end of the year	–	+	+	+	–	+	+	–	–

Source: Own work.

We can notice a different approach to both the current and the final repetition. In particular, some authors use repetition tasks to update knowledge before studying a new topic, some put tasks for repeating previously studied topics in a separate rubric, in the textbooks of the author team A. Merzliak, D. Nomirovskyi, V. Polonskyi, M. Yakir, both types of task selections are combined, and in the textbook of Ye. Nelin, there is none of them. As for the final repetition of the school mathematics course, it is natural that it can be carried out upon completion of the study of all topics, that is, at the end of grade 11, and we can observe the corresponding rubric for repetition in the textbooks of G. Bevz, V. Bevz, A. Merzliak, D. Nomirovskyi, V. Polonskyi, and M. Yakir. So, working with these textbooks, the teacher has the opportunity to use tasks from them and supplement or replace them with other means. When working with a textbook by O. Ister or Ye. Nelin, when planning a final review, the teacher only needs to use other teaching aids.

The tasks for the final review in both textbooks are presented in the form of open tasks. At the same time, the textbooks differ in the thematic distribution and quantitative composition of the proposed exercises. The topics listed for review in the textbook by G. Bevz, V. Bevz: “Numerical expressions and functions, equations and inequalities” (88 tasks), “Lines and planes in space” (13 tasks), “Derivative and integral” (27 tasks), “Geometric solids” (23 tasks), “Problems for the clever” (13 tasks) (Bevz & Bevz, 2019). In the textbook by A. Merzliak, D. Nomirovskyi, V. Polonskyi, and M. Yakir's review tasks are divided into two sections: problems for reviewing the algebra course (17 topics, a total of 207 tasks) and problems for reviewing the geometry course (9 topics, a total of 145 tasks) (Merzliak, Nomirovskyi, Polonskyi & Yakir, 2019).

Theoretical material for systematizing knowledge by topics or content lines is not provided in any of the textbooks, so the selection and design of appropriate materials for use in lessons is left to the teacher. One of the sources of concise, structured theoretical information can be collections for preparing for the EIA (NMT) in mathematics. They can also be used to select tasks for repetition. So let's consider the approaches to implementing repetition and systematization proposed in such collections.

According to the didactic purpose, the collections can be aimed at the thematic repetition of the school mathematics course ((Zakhariichenko et.al., 2022), (Halperina et.al, 2022), (Zakhariichenko et. Al, 2021), (Ister, 2021), (Kozyra, 2023), (Kapinosov, 2023), (Klochko, 2023), (Zabelyshynska et.al., 2024)) or at practical development of skills and abilities on complex tests ((Zakhariichenko et.al, 2024), (Halperina, 2024), (Martyniuk, 2024), (Ister, 2024)).

Collections for thematic repetition of each author or group of authors have a fairly stable structure from year to year and differ in minor corrections or adjustments. Let us consider the features of the collections offered by publishing houses during the years of conducting the external examination in mathematics in the NMT format. In particular, let us pay attention to the methodological approach to the order of presentation of topics, the ratio of consideration of algebra and geometry (sequentially or in parallel), the use of open-form tasks for learning and training or various tasks in the EIA (NMT) format, the use of different types of EIA (NMT) tasks in mathematics and the compliance of their form with modern requirements for these tasks, the

presentation of theoretical material, examples of solutions and similar tasks for independent practice. The relevant information on some collections is given in Table 3.

Table 3. Comparison of collections for preparing for the EIA (NMT) in mathematics

	1	2	3	4	5	6	7	8
Open-ended training exercises	+	+	–	+	+	+	+	+
Closed-form training exercises	–	–	+	+	+	+	+	–
Thematic tests in the external evaluation format	+	–	–	+	+	+	+	–
Brief background material	+	+	near tasks	–	+	–	in geometry	–
Detailed summary of the theory	–	+	–	+	+	+	+	+
Availability of examples of solving problems	–	+	+	+	+	+	+	+
Similar options	+	–	+	+	–	–	+	–
Alternating algebra and geometry topics	Sequentially	Sequentially	Sequentially	Sequentially	Sequentially	Sequentially	In parallel	Sequentially
Comprehensive tests in the external evaluation format	+	+	–	+	+	+	–	On the website

1) Zakhariichenko, Shkolnyi, Zakhariichenko & Shkolna, 2022, 2) Halperina, Zabelyshynska, Y. Zakhariichenko, Karpik & Shkolnyi, 2022, 3) Y. Zakhariichenko, Repeta, Markova & Karpik, 2022, 4) Ister, 2021, 5) Kozyra, 2023, 6) Kapinosov, 2023, 7) Klochko, 2023, 8) Zabelyshynska, Zakhariichenko & Karpik, 2024

Source: Own work.

So, as we can see from the table, in most collections, the topics of algebra and geometry are presented sequentially, and at the end, there are tasks in the format of an EIA, or there is a call to take such a test on the publisher's website. Some authors choose the approach of training on open tasks, trying to avoid replacing learning with guessing answers, and some adhere to the strategy of training specifically on tasks in the format of an external examination. Most collections contain a detailed presentation of the theory, and some of them are convenient short reference materials. Most manuals also provide examples of solving tasks, although such examples for the student can also be options solved together with the teacher from those collections that contain similar options for tasks.

In our opinion, none of the manuals provides fully differentiated independent training for students of different levels of knowledge and skills in mathematics, which is why the materials considered can become an effective tool for repetition and systematization only under the teacher's control or at least with his consultation. Thus, at the stage of repetition and systematization of knowledge and skills in mathematics, the main role of the teacher is to qualitatively diagnose the student's knowledge and effectively select the means of learning and repetition offered on the educational market, the number of which is only increasing every year.

CONCLUSIONS AND PERSPECTIVES FOR FURTHER RESEARCH

As a result of the analysis of mathematics textbooks (standard level) for 11 grades on the subject of the approach to implementing final repetition, it was found that tasks for this type of repetition are available in the textbook by G. Bevz, V. Bevz (covering some topics of the school mathematics course) and A. Merzliak, D. Nomirovskyi, V. Polonskyi, M. Yakir (covering all topics of the school mathematics course of the standard level, the sequence of topics mostly coincides with the sequence of their study). In the case of working with another textbook or if it is necessary to diversify the forms of tasks or differentiate tasks by complexity, the teacher can choose, in particular, collections for preparing for the EIA (NMT) in mathematics to implement final repetition. Such collections by different authors differ in the sequence of presentation of topics, the forms of tasks, the presence of examples and similar options, and level differentiation, and they are also designed for students with different previous mathematical training. However, no collection fully meets all the needs for high-quality systematization of students ' knowledge, not least because it does not provide feedback.

Therefore, an essential component for ensuring the proper quality of repetition and systematization of the school mathematics course is the pedagogical skill of the mathematics teacher and his ability to combine different approaches to repetition and systematization, taking into account the characteristics of the class. Indeed, no single textbook or teaching aid can provide both the preparation of students for the EIA (NMT) in mathematics and the final synthetic formation of their mathematical competence and other key competencies provided for by the NUS concept. Also, one of the problems of proper organization of systematization and repetition of the school mathematics course is the difficulty of ensuring an individual

approach for students of different levels of educational achievements in the short term that can be allocated for the implementation of this repetition.

Therefore, we propose to use a combined approach for final revision, which consists in using the resources of the textbook, study guides, and materials for preparing for the EIA (NMT) in mathematics, using the advantages of each of these guides described above in accordance with the capabilities of the class or individual student. We also see prospects in developing an adaptive approach for the revision and systematization of the school mathematics course, in particular, using digital technologies. Our further research will be devoted to this topic.

CONFLICT OF INTEREST

The authors declare no financial, personal, or other interests that could be considered a potential conflict of interest regarding the publication of this article.

FUNDING SOURCES

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

DATA AVAILABILITY

This is a theoretical study and does not involve the use of any additional datasets.

USE OF ARTIFICIAL INTELLIGENCE (AI) TOOLS

AI tools were not used in the writing of this work.

REFERENCES (TRANSLATED AND TRANSLITERATED)

1. Baddeley, A. (2000). The episodic buffer: a new component of working memory? *Trends in Cognitive Sciences, 4*(11), 417–423.
2. Bevz, H. P., & Bevz, V. H. (2018). *Matematyka: Algebra i pochatky analizu ta heometriia. Riven standartu: Pidruchnyk dlia 10 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics: Algebra and the fundamentals of analysis and geometry. Standard level: Textbook for grade 10 of general secondary education institutions*]. Kyiv: Osvita. (in Ukrainian).
3. Bevz, H. P., & Bevz, V. H. (2019). *Matematyka: Algebra i pochatky analizu ta heometriia. Riven standartu: Pidruchnyk dlia 11 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics: Algebra and the fundamentals of analysis and geometry. Standard level: Textbook for grade 11 of general secondary education institutions*]. Kyiv: Osvita. (in Ukrainian).
4. Burda, M. I., Kolesnyk, T. V., Malovanyi, Yu. I., & Tarasenkova, N. A. (2018). *Matematyka (algebra i pochatky analizu ta heometriia, riven standartu): Pidruchnyk dlia 10 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics (algebra and the fundamentals of analysis and geometry, standard level): Textbook for grade 10 of general secondary education institutions*]. Kyiv: Orion. (in Ukrainian).
5. Cabinet of Ministers of Ukraine. (2011). *Pro zatverdzhennia Derzhavnoho standartu bazovoi i povnoi zahalnoi serednoi osvity: Postanova vid 23.11.2011 No. 1392* [*On approval of the State Standard of Basic and Complete General Secondary Education: Resolution of November 23, 2011 No. 1392]*. Official Portal of the Verkhovna Rada of Ukraine. URL: https://zakon.rada.gov.ua/laws/show/1392-2011-п#Text (in Ukrainian).
6. Cabinet of Ministers of Ukraine. (2020). *Postanova No. 898 vid 30 veresnia 2020 r. "Pro deiaki pytannia derzhavnykh standartiv povnoi zahalnoi serednoi osvity"* [*Resolution No. 898 of September 30, 2020 "On certain issues of state standards of complete general secondary education"*]. URL: https://www.kmu.gov.ua/npas/pro-deyaki-pitannya-derzhavnih-standartiv-povnoyi-zagalnoyi-serednoyi-osviti-i300920-898 (in Ukrainian).
7. Cabinet of Ministers of Ukraine. (2024). *Postanova No. 851 vid 23 serpnia 2024 r. "Pro zatverdzhennia Derzhavnoho standartu profilnoi serednoi osvity"* [*Resolution No. 851 of August 23, 2024 "On approval of the State Standard of Specialized Secondary Education"*]. URL: https://zakon.rada.gov.ua/laws/show/851-2024-п#Text (in Ukrainian).
8. Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed practice in verbal recall tasks: A review and quantitative synthesis. *Psychological Bulletin, 132*(3), 354–380.
9. Ebbinghaus, H. (1885). *Über das Gedächtnis [On Memory]*. Leipzig: Duncker & Humblot.
10. Halperina, A. R. (2024). *NMT 2025. Matematyka: Typovi testovi zavdannia* [*NMT 2025. Mathematics: Typical test tasks*]. Kyiv: Litera LTD. (in Ukrainian).
11. Halperina, A. R., Zabelyshevska, M. Ya., Zakhariichenko, Yu. O., Karpik, V. V., & Shkolnyi, O. V. (2022). *Matematyka. Kompleksne vydannia (dovidnyk z matematyky z trenuvialnymy vpravamy za 5–11 klasy. Testy.) (17-te vyd.)* [*Mathematics. Comprehensive edition (a mathematics handbook with practice exercises for grades 5–11. Tests.) (17th ed.)*]. Kyiv: Litera LTD. (in Ukrainian).
12. Ister, O. S. (2018). *Matematyka (algebra i pochatky analizu ta heometriia, riven standartu): Pidruchnyk dlia 10 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics (algebra and the fundamentals of analysis and geometry, standard level): Textbook for grade 10 of general secondary education institutions*]. Kyiv: Geneza. (in Ukrainian).
13. Ister, O. S. (2019). *Matematyka (algebra i pochatky analizu ta heometriia, riven standartu): Pidruchnyk dlia 11 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics (algebra and the fundamentals of analysis and geometry, standard level): Textbook for grade 11 of general secondary education institutions*]. Kyiv: Geneza. (in Ukrainian).
14. Ister, O. S. (2021). *Matematyka: kompleksna pidhotovka do zovnishnoho nezalezhnoho otsiniuvannia (3-tie vyd.)* [*Mathematics: Comprehensive preparation for external independent testing (3rd ed.)*]. Kyiv: Geneza. (in Ukrainian).
15. Ister, O. S. (2024). *NMT 2025. Matematyka: 10 variantiv u formati NMT* [*NMT 2025. Mathematics: 10 test versions in NMT format*]. Kharkiv: Abetka. (in Ukrainian).
16. Kang, S. H. K. (2016). Spaced repetition promotes efficient and effective learning: Policy implications for instruction. *Policy Insights from the Behavioral and Brain Sciences, 3*(1), 12-19.
17. Kapinosov, A. M. (2023). *Matematyka. Kompleksna pidhotovka do ZNO (NMT)* [*Mathematics. Comprehensive preparation for EIT (NMT)*]. Ternopil: Pidruchnyky i posibnyky. (in Ukrainian).

18. Klochko, I. Ya. (2023). *Matematyka: testovi zavdannia (zovnishnie nezalezhne otsiniuvannia)* [*Mathematics: test tasks. external independent assessment*]. Ternopil: Navchalna knyha – Bohdan. (in Ukrainian).
19. Kozyra, V. M. (2023). *Matematyka: zovnishnie nezalezhne otsiniuvannia (2-he vyd.)* [*Mathematics: External Independent Testing (2nd ed.)*]. Ternopil: Aston. (in Ukrainian).
20. Martyniuk, O. V. (2024). *NMT 2025. Matematyka: Testovi zavdannia u formati NMT* [*NMT 2025. Mathematics: Test tasks in NMT format*]. Ternopil: Pidruchnyky i posibnyky. (in Ukrainian).
21. Merzliak, A. H., Nomirovskyi, D. A., Polonskyi, V. B., & Yakir, M. S. (2018). *Matematyka: Algebra i pochatky analizu ta heometriia, riven standartu: Pidruchnyk dlia 10 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics: Algebra and the fundamentals of analysis and geometry, standard level: Textbook for grade 10 of general secondary education institutions*]. Kharkiv: Himnaziia. (in Ukrainian).
22. Merzliak, A. H., Nomirovskyi, D. A., Polonskyi, V. B., & Yakir, M. S. (2019). *Matematyka: Algebra i pochatky analizu ta heometriia, riven standartu: Pidruchnyk dlia 11 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics: Algebra and the fundamentals of analysis and geometry, standard level: Textbook for grade 11 of general secondary education institutions*]. Kharkiv: Himnaziia. (in Ukrainian).
23. Ministry of Education and Science of Ukraine. (2016). *Nova ukraiinska shkola: Kontseptualni zasady reformuvannia serednoii shkoly* [*The New Ukrainian School: Conceptual foundations for the reform of secondary education*]. URL: https://mon.gov.ua/static-objects/mon/sites/1/zagalna%20serednya/nova-ukrainska-shkola-compressed.pdf (in Ukrainian).
24. Ministry of Education and Science of Ukraine. (2017). *Navchalna prohrama z matematyky dlia uchniv 10–11 klasiv zakladiv zahalnoi serednoi osvity. Profilnyi riven. Zatverdzheno nakazom MON Ukrainy vid 23.10.2017 No. 1407*[*Mathematics curriculum for students of grades 10–11 of general secondary education institutions. Specialized level. Approved by the order of the Ministry of Education and Science of Ukraine No. 1407 dated October 23, 2017*]. URL: https://mon.gov.ua/static-objects/mon/sites/1/zagalna%20serednya/programy-10-11-klas/2018-2019/matematika-profilnij-rivenfinal.docx (in Ukrainian).
25. Ministry of Education and Science of Ukraine. (2017). *Navchalna prohrama z matematyky dlia uchniv 10–11 klasiv zakladiv zahalnoi serednoi osvity. Riven standartu. Zatverdzheno nakazom MON Ukrainy vid 23.10.2017 No. 1407* [*Mathematics curriculum for students of grades 10–11 of general secondary education institutions. Standard level. Approved by the order of the Ministry of Education and Science of Ukraine No. 1407 dated October 23, 2017*]. URL: https://mon.gov.ua/static-objects/mon/sites/1/zagalna%20serednya/programy-10-11-klas/2018-2019/matematika.-riven-standartu.docx (in Ukrainian).
26. Ministry of Education and Science of Ukraine. (2019). *Nakaz No. 1513 vid 04 hrudnia 2019 r. "Pro zatverdzhennia prohramy zovnishnoho nezalezhnoho otsiniuvannia z matematyky"* [*Order No. 1513 of December 4, 2019 "On approval of the External Independent Testing program in mathematics"*]. URL: https://testportal.gov.ua/progmath/ (in Ukrainian).
27. Nelin, Ye. P. (2018). *Matematyka (algebra i pochatky analizu ta heometriia, riven standartu): Pidruchnyk dlia 10 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics (algebra and the fundamentals of analysis and geometry, standard level): Textbook for grade 10 of general secondary education institutions*]. Kharkiv: Ranok. (in Ukrainian).
28. Nelin, Ye. P., & Dolhova, O. Ye. (2019). *Matematyka (algebra i pochatky analizu ta heometriia, riven standartu): Pidruchnyk dlia 11 klasy zakladiv zahalnoi serednoi osvity* [*Mathematics (algebra and the fundamentals of analysis and geometry, standard level): Textbook for grade 11 of general secondary education institutions*]. Kharkiv: Ranok. (in Ukrainian).
29. Rakov, S. A. (2005). *Matematychna osvita: kompetentnisnyi pidkhid z vykorystanniam IKT* [*Mathematics education: Competency-based approach using ICT*]. Kharkiv: Fakt. (in Ukrainian).
30. Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive Load Theory*. Springer.
31. Ukrainian Center for Educational Quality Assessment (UCEQA). (2023). *Natsionalnyi multypredmetnyi test 2023 roku: Zvit. Tom 2* [*National Multi-Subject Test 2023: Report. Volume 2*]. URL: https://testportal.gov.ua/wp-content/uploads/2023/08/ZVIT-NMT_2023-Tom_2.pdf (in Ukrainian).
32. Ukrainian Center for Educational Quality Assessment (UCEQA). (2024). *Natsionalnyi multypredmetnyi test 2024 roku: Zvit. Tom 2* [*National Multi-Subject Test 2024: Report. Volume 2*]. URL: https://testportal.gov.ua/wp-content/uploads/2024/09/Zvit-NMT_2024-Tom_2_red.pdf (in Ukrainian).
33. Verkhovna Rada of Ukraine. (2017). *Zakon Ukrainy "Pro osvitu" No. 2145-VIII vid 05.09.2017 r.* [*Law of Ukraine "On Education" No. 2145-VIII of September 5, 2017*]. URL: https://zakon.rada.gov.ua/laws/show/2145-19#Text (in Ukrainian).
34. Zabelyshynska, M. Ya., Zakhariichenko, Yu. O., & Karpik, V. V. (2024). *Matematyka: Dovidnyk-praktykum (2-he vyd.)* [*Mathematics: Reference-practicum (2nd ed.)*]. Kharkiv: Ranok. (in Ukrainian).
35. Zakhariichenko, Yu. O., Repeta, V. K., Markova, I. S., & Karpik, V. V. (2021). *Matematyka: 2000 testiv dlia pidhotovky do ZNO* [*Mathematics: 2000 tests for preparation for EIT*]. Kyiv: Litera LTD. (in Ukrainian).
36. Zakhariichenko, Yu. O., Shkolnyi, O. V., Rohanin, O. M., & Derhachov, V. A. (2024). *NMT 2025. Matematyka: Use dlia pidhotovky do NMT v rezhymi onlain i oflain* [*NMT 2025. Mathematics: Everything for NMT preparation in online and offline formats*]. Kharkiv: Ranok. (in Ukrainian).
37. Zakhariichenko, Yu. O., Shkolnyi, O. V., Zakhariichenko, L. I., & Shkolna, O. V. (2022). *Suchasna pidhotovka do ZNO z matematyky* [*Modern preparation for EIT in mathematics*]. Kamianets-Podilskyi: Aksioma. (in Ukrainian).

| *Received: 19.06.2025* | *Accepted: 27.07.2025* | *Published: 29.09.2025* |

This work is licensed under Creative Commons Attribution-NonCommercial-ShareAlike 4.0 International License.