Thinking and formation of cognitive abilities is determined by cognitive experience. The new experience increases potential of cognitive abilities and expands cognitive space of the individual. Apparently, cognitive abilities determine the dynamics of the cognitive process and the functional level of thinking as a developing process. As a result the conditions for further development of the functional capabilities of the internal mechanisms of cognitive space are created. The basis of the mechanism of thinking, as a cognitive multistage mechanism, are perception and understanding of the information received, which determine unconscious basis of thinking and are responsible for its content (cognitive experience) and form (integration potential).

Mental space is considered as a space in which the images of information flows, previously contained in cognitive memory, interact, transform and line up in organized structures. The article is dedicated to the connection between the mental space of the individual as a space of functional transformations that are laid during the time of life, and the degree of development of cognitive abilities of the individual.

The internal mechanisms that determine transformation of model representations of the secondary images in the mental space is studied. It is proved that these mechanisms determine the dynamics and direction of the process of organization of structures of secondary information flows, of the process of thinking.

A detailed study of cognitive mechanisms of thinking, as intuitive mechanisms of processing previously obtained information, will determine the approach to further development and understanding of the basic foundations of the cognitive process and improvement of educational technologies for possible enhance of the process of thinking, provide professional and cultural development of the individual in modern institutions of higher education.

***Key words**: cognitive space, cognitive mechanisms of thinking, level of "cognitive unconscious", unconscious basis of thinking, secondary information flows.*

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Elina Zhelezniakova
Simon Kuznets Kharkiv National University of Economics
ORCID ID 0000-0001-6409-4761
Tetiana Silichova
Simon Kuznets Kharkiv National University of Economics
ORCID ID 0000-0001-5003-2711
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THE PATH TO SUCCESS IN EIA IN MATHEMATICS: INDIVIDUAL ASPECTS AND QUESTIONS

Analysis of existing disadvantages in the process of preparing and passing exams of external independent assessment in mathematics among domestic schoolchildren and applicants has been carried out. The main problems that occur in the process of training and preparing for exams of this type were identified. The possible directions of modernization of the educational process were outlined which, if followed, can cause a significant improvement in the level of mathematical knowledge and, as a consequence, an improvement in the results of mathematics examinations among schoolchildren and applicants. The necessity of using both "old" and "new" teaching methods, their constant adjustment and improvement were emphasized. The experience of mathematical education among other countries is given and analyzed. According

to the study, it was stated that, in general, properly organized school preparation in mathematics is a prerequisite for passing exams.

***Keywords**: task, knowledge, EIA, exam, mathematics, educational process, level of mathematical education, assessment system.*

Introduction. The leading countries of the world pay considerable attention to the level of mathematical preparation, starting with pupils of the junior school, ending with applicants and first-year students, because the industrial and scientific level of the country is a guarantee of a high standard of living of its citizens and further development of society. According to the International Campaign for the Study of Mathematics in Students and Entrepreneurs (Trend in Mathematics and Science Study), it is known that at present the best positions on the level of mathematical preparation are taken by students from Hong Kong, Singapore, Taiwan, followed by students from Japan, Kazakhstan and Russia. Unfortunately, in this ranking, Ukraine is in the last position, ahead of only the countries of Africa and the Persian Gulf (the study was conducted in 50 countries, and covered schoolchildren from 10 to 16 years old) (Common Core State Standard Initiative, 2019; Smarter Balanced Assessment Consortium, 2019). However, despite the complexity of the subject itself, more and more students choose mathematics as the second subject for EIA after Ukrainian language and literature. This can be explained by two main reasons.

Firstly, mathematics is one of the main educational subjects and its role is growing rapidly. Mathematics is a basic compulsory discipline, an examination in which must be compiled not only in order to enter the most prestigious universities in the world, but also to obtain a document confirming complete school education. Secondly, mathematical knowledge is universal, they are not obsolete, but only supplemented, they are the same in any country in the world, and a modern successful career is already practically impossible without mathematical knowledge. The popularity of the choice of mathematics as the main subject of external independent testing in Ukraine can be confirmed by the following statistical data of the Ukrainian Center for Educational Quality Assessment. Thus, in 2016, 123047 people (93,1 % of the total number of registered) took part in the external independent testing of mathematics, 106325 people in 2017 (94 % of the total number of registered), in 2018 – 106483 people (95 % of the total number of registered). However, by 2016, 15 %, in 2017, 16 % and in 2018, 18,57 % of the participants could not cross the minimum threshold or pass the exam. Thus, we can conclude that positive dynamics, unfortunately, is absent (Ukrainian Center for Educational Evaluation, 2019, p. 1).

Analysis of relevant research. Questions of mathematical education are discussed by many scholars and teachers. Particular attention is paid to the mathematical training which is responsible for the transition from school to university education. Thus, some issues concerning difficulties in higher education, problems in the preparation for independent examinations were covered in works

by O. M. Bezumov, A. S. Tomilov, O. V. Hladkyi, M. B. Shashkin, O. O. Tabinov and others. This group of scholars believes that it is precisely the lack of school preparation time in mathematics and is a major negative factor that does not contribute to improving the level of mathematical knowledge. It is impossible to disagree with this because in ordinary general secondary schools only 3 hours per week are spent on math training in upper grades, which does not allow full coverage of the material submitted to the external independent assessment examination. Interesting is the opinion of V. A. Bolotov, E. A. Sedova, H. S. Kovaleva, who according to their own research show that use of such methods as unconscious material memory leads to the fact that even a slight deviation from the standard problem causes difficulties among students. So, a small change in the condition of the problem leads to the fact that percentage of students who can solve it immediately decreases by 15–20 %. It should also be noted that majority of schoolchildren face the difficulties of real perception of mathematical problems, especially in the case of solving geometric problems or real "life" tasks. About 30 % of entrants can not only accurately portray, but imagine and appreciate the scale of real objects and events (Bolotov et al., 2012, p. 35).

I. V. Akimov and O. I. Titov draw attention to the lack of structuring in mathematical knowledge, that is, many topics in the school course of mathematics are taught as if they "live" by themselves, and the entrants do not see either mathematical or logical connectivity, which also reduces the possibility of obtaining higher scores in EIA in mathematics (Akimova, 2014, p. 141).

V. A. Testov draws attention to existing disparity in mathematical descriptions and concepts, lack of a unified method of teaching in various textbooks, which virtually reduces the possibility for students to independently prepare for exams (Bolotov et al., 2012; Smarter Balanced Assessment Consortium, 2019).

In light of the above mentioned, it is also worthwhile to provide comparative experience of domestic scientists and teachers who were able to appreciate the advantages in mathematical preparation of domestic students and pupils from other countries. For example, from the US experience: indeed, the average level of general schooling is not high; the prestige of mathematical education is gradually increasing.

So, according to the American Bureau of Labor Statistics, in the future, the labor market and the share of the best paying for professions directly related to precise sciences will increase significantly, so the number of entrants who wish to gain knowledge in the natural sciences and in the physical and mathematical direction is increasing (National Center for Educational Statistics, 2015 , p.1).

The most prestigious private schools in the United States devote much attention to the study of mathematics; the level of mathematical knowledge is constantly checked and controlled. So for students of the 5th grade, the SBAC educational test examines the state of formation and availability of the following problem-solving skills in the subjects of the natural sciences cycle. These skills

cover a wide range of acquired skills and knowledge in the learning process: ability to read information from any model; ability to use the result of one task when solving the second; ability to explain the result not only with the help of words, but also drawings, graphs, schemes; ability to reformulate the condition of tasks, and much more. It should also be noted that most problem-solving skills are quite diverse in their internal structure. Thus, ability to read information from a variety of models can be either an immediate solution to a task by the condition of a mathematical record or usual word articulation, or, conversely, ability to read and analyze information using graphs and charts only (Testov, 2014, p. 4).

The **aim** of this article is to identify the main problems and reasons that hinder the increase of the level of mathematical preparation among the entrants, a comprehensive analysis of the identified problem, and determining directions for its solution.

Research Methods: analysis of philosophical, psychological-pedagogical and methodical literature, statistical methods of observation, analysis of own teachers' experience from work and study with a different kind of the students at the universities.

Results. Observations of recent years suggest that: the need to participate in external independent assessment in mathematics encourages students to improve their own knowledge of the subject, forming a more responsible attitude to them. An analysis of the experience of conducting external independent assessment indicates the importance of preliminary preparation of students for this form of control. A significant part of the students is difficult to carry out test tasks in a timely manner; clearly, consistently, logically substantiate the steps of the tasks of the third part. This indicates an inadequate level of formation of so-called technological competence, which is important in practice. Taking into account own experience, analyzing the results of scientific works, the results of conducted statistical surveys can be divided into the causes of "difficulties" in the preparation for external independent assessment in mathematics in two main categories: stress and unpreparedness. Most students are often mistaken for relatively simple calculations, and the reason is the haste and inattention.

The stress load that arises during examinations of this kind has two reasons for its occurrence and can not be completely eliminated, but it can be substantially reduced. Firstly, the situation of exam preparation of such a level of importance, which gives rise to a situation of high psychological tension, is complicated. To eliminate this, psychologists and educators have developed a system of tips that can help students cope with excessive psychological stress. For example, do not be upset, adjust to success, while thinking about the current task, and not less important – sleep on the eve of exam. In preparing for external independent assessment, the teacher must take into account the psychological aspect – not to offend and not to injure the students, to adjust them for success and to apply in the lessons the test forms of the tasks using

self-assessment and mutual evaluation. This psychological advice should be given to the students during training, be discussed with them as much as possible, and it should be brought to the consciousness of the students so that at the right moment they can take advantage of it.

Another reason for stress may be lack of confidence in their own knowledge, which also generates confusion and frustration. The content of the certification work on mathematics is determined by the Program of external independent assessment of mathematics for persons who wish to obtain higher education on the basis of complete secondary education, approved by the order of the Ministry of Education and Science of Ukraine dated 03/02/2016 No. 77 "On approval of external independent assessment programs for individuals who wish to obtain higher education on the basis of complete secondary education". Criteria for evaluating open-form tasks with a detailed response of the certification work in mathematics of external independent assessment in 2019 was approved by the order of the Ukrainian Center for the Evaluation of the Quality of Education dated 22.10.2018, No. 158 "On Approval of the Criteria for Evaluation of Open Form Problems with the Expanded Answer of the Certification Works of the External Independent Assessment in 2019».

The certification work in mathematics contains 33 tasks: a task with the choice of one correct answer (test tasks №№1–20), the task for establishing conformity ("logical pairs" №№ 21–24), the task of an open form with a short answer – structured (№№ 25, 26) and unstructured (№№27–30), an open form task with a detailed answer (№№ 31–33). Thus, about 60 % of the tasks are test tasks. Therefore, special attention should be paid to tests when preparing for external independent assessment. It is worth remembering that for tasks to be performed with the choice of one correct answer it is necessary to spend approximately one minute, and a few correct answers or the establishment of correspondences – one and a half minutes. It is important to teach students to perform tasks not only correctly, but also quickly, in order to maximally bring them closer to the conditions in which graduates will work during external independent assessment (Zhelezniakova & Zmiivskaja, 2016, p. 38). At this stage, students should be taught the algorithms for performing test tasks of various forms, analyze the results of testing, identify common errors and identify ways to eliminate them. It is advisable to give the student specific instructions on how to fix the errors found.

So, when solving linear inequalities, one of the basic steps is division (or multiplication) of both parts of the inequality into a number. Quite often, when dividing (or multiplying) by a negative number, pupils are forgetting to change the sign of the inequality to the opposite. Another mistake that is often admitted when performing the tasks of external independent assessment is the disclosure of the brackets preceded by a minus sign, especially when subtracting two rational fractions.

Therefore, we can assume that first condition for the successful completion of external independent assessment is systematization and synthesis of theoretical material provided by the math program for external independent assessment and methods for solving the main types of tasks.

It is expedient to systematize and generalize the theoretical material and methods of solving tasks by the content lines of the school course of mathematics:

- numbers and expressions;
- equation and inequality;
- functions;
- elements of combinatorics, principles of probability theory and elements of statistics;
- planimetrics;
- stereometry.

Second condition for the successful completion of external independent assessment is ability to determine or have a clear idea of existence of related topics.

Very often the names of the characteristics of the function “area of definition” and “area of values” confuse. Because of this, the task condition is misunderstood. Or, when solving an equation or inequality that has restrictions on the domain of admissible values, the tasks contain a variant of the answer without taking into account the domain of admissible values. That is, the test is precisely this way and is designed to verify that the student knows (or remembers) the limitations that may be imposed on the task or not.

Another example. The module is always positive (non-negative), there is no error here. But if you want to simplify the expression with the module, then under certain conditions or assumptions for the variable that is under the module, it is revealed with a minus.

Calculate the value of two expressions: $\sqrt{\left(2-\sqrt{3}\right)^2}$ and $\sqrt{(\sqrt{3}-2)^2}$.

Very often in this case the following solutions are obtained:

1) $\sqrt{\left(2-\sqrt{3}\right)^2}=2-\sqrt{3}$;

2) 2) $\sqrt{(\sqrt{3}-2)^2}=\sqrt{3}-2$.

At the same time, most entrants do not take into account that when calculating the root of a positive degree, the result of the calculation should also be positive (arithmetic root). The correct answer takes the form:

1) $\sqrt{\left(2-\sqrt{3}\right)^2}=\sqrt{(\sqrt{3}-2)^2}=\left|2-\sqrt{3}\right|=2-\sqrt{3}$, because $2-\sqrt{3}>0$;

2) $\sqrt{\left(2-\sqrt{3}\right)^2}=\sqrt{(\sqrt{3}-2)^2}=\left|\sqrt{3}-2\right|=-\left(\sqrt{3}-2\right)=2-\sqrt{3}$, because $\sqrt{3}-2<0$.

Thus, the correct answer is the same in both cases.

Third condition for the successful completion of external independent assessment is ability to use associative thinking to solve problems. In the process of preparation for external independent assessment, it is expedient to pay considerable attention to improving the skills and abilities of constructing and researching mathematical models of real objects, processes and phenomena; analysis of the information given in graphical, tabular, and text forms.

Fourth condition for the successful completion of external independent assessment is ability to evaluate the results analytically. Particular attention should be paid to the formation of skills and ability to establish correspondence between the graphs of functions and properties of these functions given in the figures. It is advisable to solve the problems of applied direction using the basic statistical formulas, geometric problems of practical content.

Fifth condition for a successful external independent assessment is ability to manage their own time. When solving tasks with the choice of one correct answer: it is sometimes advisable not to look for the correct answer right away, and consistently exclude those answer variants that are clearly not appropriate. One of the ways of solving this issue is the expedient choice of the problem solving direction, and finding only a clear answer to the problem. When solving test tasks with a short answer to solving equations, inequalities and their systems, it is required to write down the sum of the roots, the product of the roots, the smallest root, the smallest solution of inequality, and so on. It is worth stressing the students need to interpret the received answer, taking into account the condition of the problem. Another situation is a situation where the student needs to clearly and carefully understand the task, and not to perform “extra” actions.

In preparing for external independent assessment, it is advisable to familiarize students with testing technique, accustom them to performing tasks not only correctly, but also quickly, constantly monitoring the time to maximally bring them closer to the conditions in which graduates will work during external independent assessment. One of the important moments of this technique is to train continuous self-control of time to save time in solving the most complex tasks. When performing the tasks of the first and second parts it is advisable to use an oral counting, therefore, in the process of preparation for external independent assessment, it is necessary to develop the skills of the oral counting.

It is worth focusing students’ attention on the graphical method of solving equations and equation systems, because quite often, if the test task refers to the number of roots of the equation or solutions of the system of equations, the graphical method is the simplest.

For example, let's answer the following question: "How many solutions has a system of equations?

$$\begin{cases} x^2 + y^2 = 9, \text{„} \\ x - y = 3? \end{cases}$$

Under the condition of this task, it is not necessary to find the meaning of the system variables themselves; only one must determine the existence of solutions in general and their quantities. Therefore, the use of the usual analytical solution of this system is not appropriate, but also leads to waste of time.

In the case of a graphical solution of this system, where $x^2 + y^2 = 9$– the equation of a circle with a center at the origin and radius $R = 3$, $x - y = 3$– equation of the straight line, we find that this system has two solutions (Fig. 1).

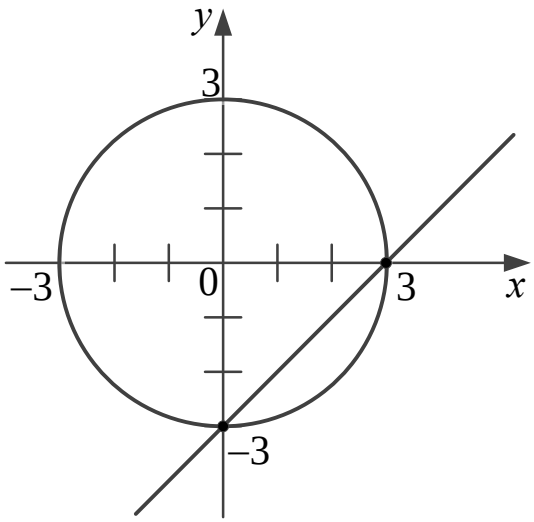

Fig. 1. Graphical solution of the system of equations

Students should be encouraged to leave the geometric tasks to the end, because it takes a lot of time, and experience shows that students are better prepared than algebra to geometry.

In the process of preparing for external independent assessment, it is necessary to develop algorithms for performing test tasks of various forms, systematically analyze the results of testing, and identify common errors and ways to eliminate them. Qualitative preparation for external independent assessment involves organization of self-educational activities of students in the repetition of the course of mathematics. Online help will be very useful for this. Today you can find plenty of resources for quite good quality training. Particularly, such assistance is appropriate for rural school graduates. Because, due to specificity, mainly socio-economic factors, at the start of the introductory campaign, graduates of rural education institutions are losing to graduates of city schools. In order to ensure a balance of training, teachers of Kharkiv universities conduct trainings in education institutions of the regional districts (Zhelezniakova & Silichova, 2018, p. 188).

Simon Kuznets Kharkiv National University of Economics is continuously working with students from the graduating classes of the city and region to prepare them for external independent assessment. University experts have created a chat bot HNEU_ZNO_math_bot, which helps students prepare for external independent assessment. Telegram users can take advantage of the service. Also, as part of the school support project, #SHOW is SOFTWARE, an instagram account is launched https://www.instagram.com/zno_prosto/that helps prepare for external independent assessment. Content hosted by this account is developed by leading university professors. The visual and graphical presentation of the material available helps students spend time using social networks and aims to improve the quality of preparation for external independent assessment.

Conclusions. External independent assessment is one of the most effective and popular systems of assessment of student achievements in the world, which allows both final certification and selection of entrants for higher education institutions. In connection with the fact that mandatory condition for admission to higher education institutions of persons with complete secondary education is a certificate of external independent assessment in certain subjects (the list of subjects depends on the higher education institution and a specific specialty), then one of the pedagogical problems of today is preparation of students for external independent assessment in the process of studying at school. In our opinion, important steps in solving this problem are creation of high-quality educational and methodological literature and development of a system (or several alternative systems) for preparation for external independent assessment in mathematics with proper testing.

Thus, a successful external independent assessment in mathematics is quite possible for the average student on the condition of high-quality mathematical education on the themes of the school curriculum; it does not always require excessive effort and additional knowledge beyond the school course.

To do this it is only necessary:

- to be well-orientated in all the definitions, theorems and axioms of mathematics according to the school curriculum;
- to have own time management skills;
- to know not only standard but also non-standard ways of solving problems;
- to be able to analyze one's own time;
- to be sure of one's strength.

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АНОТАЦІЯ

Железнякова Еліна, Сілічова Тетяна. Шлях до успіху у ЗНО з математики: окремі аспекти та питання.

Проведено аналіз існуючих недоліків щодо підготовки та складання іспитів зовнішнього незалежного оцінювання з математики серед вітчизняних школярів та абітурієнтів. Визначено основну низку проблем, які мають місце у процесі навчання та підготовки до випробувань подобного типу. Окреслено можливі напрями модернізації навчального процесу, за умови виконання яких може відбуватися суттєве зростання математичних знань, і, як наслідок, покращення результатів математичних іспитів серед школярів та абітурієнтів. Звернено увагу на необхідність застосування як «старих», так і «нових» методів навчання, їх постійне корегування та вдосконалення. Наведено та проаналізовано досвід математичної освіти серед інших країн. Згідно з

проведеним дослідженням зроблено висновок, що правильна організація підготовки учнів із математики є запорукою успішного складання іспитів.

Доведено, що зовнішнє незалежне оцінювання є однією з найбільш ефективних і популярних систем оцінювання студентських досягнень у світі, що дозволяє не тільки провести атестації випускників, але й здійснити відбір абітурієнтів до закладів вищої освіти. У зв'язку з тим, що обов'язковою умовою прийому до закладів вищої освіти осіб із повною середньою освітою є сертифікат зовнішнього незалежного оцінювання з певних предметів (перелік дисциплін залежить від закладу вищої освіти й конкретної спеціальності), однією з актуальних педагогічних проблем сучасності є підготовка студентів до зовнішнього незалежного оцінювання в процесі навчання в школі. Автори вбачають важливими кроками у вирішенні цієї проблеми створення високоякісної навчально-методичної літератури та розробку системи (або декількох альтернативних систем) для підготовки до зовнішнього незалежного оцінювання з математики при належному тестуванні.

***Ключові слова**: завдання, знання, ЗНО, іспит, математика, навчальний процес, рівень математичної підготовки, система оцінювання.*

РЕЗЮМЕ

Железнякова Эллина, Силичева Татьяна. Путь к успеху в ВНО по математике: некоторые аспекты и вопросы.

Проведен анализ существующих недостатков в процессе подготовки и сдачи экзаменов внешнего независимого оценивания по математике среди отечественных школьников и абитуриентов. Определены основные проблемы, которые имеют место в процессе обучения и подготовки к экзаменам такого типа. Очерчены возможные направления модернизации учебного процесса при условии, выполнения которых может происходить существенное улучшение уровня математических знаний и, как следствие, улучшение результатов экзаменов по математике среди школьников и абитуриентов. Подчеркнута необходимость использования как «старых», так и «новых» методов обучения, их постоянной корректировки и усовершенствования. Приведен и проанализирован опыт математического образования среди других стран. Согласно проведенному исследованию сделан вывод, что в целом верным образом организованная школьная подготовка по математике является условием успешной сдачи экзаменов.

***Ключевые слова:** задание, знание, ВНО, экзамен, математика, учебный процесс, уровень математического образования, система оценивания.*

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Наталія Лавриченко
Глухівський національний педагогічний
університет імені Олександра Довженка
ORCID ID 0000-0003-0776-7362
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ПЕДАГОГІЧНІ НОТАТКИ ПРО ВУНДЕРКІНДІВ

У статті проаналізовано сучасні наукові підходи до дослідження дітей-вундеркіндів як окремої категорії обдарованих дітей. Пов'язані з вундеркіндами педагогічні проблеми розглянуто в теоретичному і практичному аспектах. Особлива