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USING OF ICT DURING PREPARATION FOR EIA: WAYS TO SEARCH FOR THE OPTIMAL MODEL

ABSTRACT

Formulation of the problem. The urgency of improving the methodology of preparation for the external examination in mathematics is currently beyond doubt. Earlier we found that electronic tools in preparation for EIA in mathematics are unpopular among entrants, but positive trends in the development of ICT to prepare for testing in mathematics are also present. The current motivation for the use of technology in mathematics teaching is the current pandemic situation, when the introduction of quarantines and long periods of online learning are beginning to be perceived by students and teachers as normal learning situations. Under these circumstances, mathematics teachers are forced to use ICT, create and develop new forms of organization of the educational process, improve and adapt teaching methods and technologies. The purpose of this article is to establish the feasibility of using ICT, their place and role in preparing for external evaluation in mathematics from the standpoint of teachers and tutors, as well as to determine how modern technology helps or hinders the search for optimal methods of preparation for this type of assessment.

Materials and methods. To achieve the goals of the article, we use empirical methods: our own survey using an electronic tool (Google form), monitoring the learning process of students, as well as analysis of their achievements results. In the paper we use the set of scientific cognition methods: comparative analysis to clarify different views on the problem; systematization and generalization to formulate conclusions and methodological advices; generalization of the author's pedagogical experience and observations.

Results. According to our survey of mathematics teachers, two thirds of them believe that the most optimal way to prepare for EIA is a combination of classroom classes and online format. 98% of respondents consider that using of ICT appropriate in preparation for external examination, and the leader among these technologies are online test platforms (NaUrok, osvita.ua, Vseosvita, Quizlet, Classtime). 97% of respondents find the use of electronic tools in preparation for the EIA in mathematics useful, and 28% are completely satisfied with both the quantity and quality of available electronic resources. At the same time, 72% of teachers believe that the number of e-learning tools should be increased and their quality should be improved, which indicates the need to develop and improve this area.

Conclusions. There is no universal methodology of preparation for the external examination in mathematics, as it significantly depends on both the student audience and the individual characteristics of the teacher or tutor who carries it out. EIA is only a tool for adequate evaluation of the student's achievement level and cannot be the goal of schooling. Instead, the main purpose of schooling is the development of the child, the disclosure of his abilities, as well as the formation of those competencies that will allow him to find his place in life, to be realized as a person. Therefore, in preparation for the external examination in mathematics, the main goal for the teacher, we consider the repetition and systematization of the school course of mathematics, rather than formal training of students to solve specific classes of test tasks. The use of ICT is perceived by us as a natural complement to the educational process, and not just as a forced step due to training in quarantine conditions. We believe that the use of electronic tools in preparation for the EIA in mathematics is useful, but it is important to ensure the proper quality of the tests offered to teachers and students on a variety of online platforms.

KEY WORDS: EIA and SFA in mathematics, information and communication technologies, e-learning aids.

INTRODUCTION

Problem formulation and analysis of current research. There is no doubt about the urgency of improving the methodology of preparation for External Independent Assessment (EIA) of academic achievements of Ukrainian graduates. This type of national standardized assessment in Ukraine is constantly in the focus of attention of both fundamental research (see (Dvoretzka, 2015)), (Liashenko & Rakov, 2008), (Ilyakoveva & Kaplun, 2019), etc.) and publications in the media (see (Rating Group Ukraine, 2018), (NaUrok, 2021), (Shvadchak, 2021), etc). At the same time, the attitude to EIA in general and to EIA in mathematics in particular in Ukrainian society as a whole is positive.

For example, a survey of more than 700 users (students, their parents and math teachers) of the GIOS educational platform (GIOS, 2021) show that the average score for the quality of external evaluation in mathematics in Ukraine on a 10-point scale (1 - the lowest level of satisfaction, 10 - the highest) is 7, and the most popular value of this quality is 8. Among the biggest advantages of independent assessment are often called: the reducing corruption during entering to universities (42% of respondents), the ability to objectively assess the level of academic achievement of students in mathematics (28%), the possibility of a wider choice of educational institutions during the admission campaign (26%) and increase the prestige of studying mathematics at school (18%).

However, according to the same poll, 39% of respondents said that the EIA in mathematics has no advantages, and among the disadvantages most often pointed out that the EIA in mathematics: can force students to study a subject they do not like (59% of respondents), does psychological pressure on students (36%), increases the number of homework (34%), does not allow to enter the dream university (26%), distorts the real situation during assessing the level of student achievement (14% of respondents). It should also be noted that 13% of respondents indicated that the EIA in mathematics has no shortcomings. We will return to other data of this survey later in this article.

In our previous work (Shkolnyi & Tykhonenko, 2021) we focused in detail on the place and role of EIA in mathematics in the Ukrainian education system, as well as on the basis of our own statistical survey of Ukrainian graduates and first-year students clarified the feasibility and possibility of using information and communication technologies (ICT) in preparation for the external examination in mathematics. In particular, we found that electronic tools in preparation for the EIA in mathematics are still unpopular among graduates. The main reasons for this are the general weak level of technology dissemination in our country, and the list of electronic resources used by students in preparation for independent assessment in mathematics is quite limited. In general, the market of e-support for mathematical education in Ukraine is, in fact, empty, because the software currently available in this market does not satisfy the needs of potential users. That is why offline courses and tutors are now the most common choice of entrants in preparation for the external testing in mathematics (Shkolnyi & Tykhonenko, 2021).

However, in our opinion, positive trends in the development of ICT for teaching mathematics in general and preparation for EIA in particular are still present, because, as the same survey of students shows, more than 80% of them are positive about the use of electronic tools in preparation for EIA in mathematics, and only about 5% have a negative perception of such resources (Shkolnyi & Tykhonenko, 2021). A strong motivation for the development of ICT in mathematics education has also been the current pandemic situation, when the introduction of quarantine and long periods of online learning are already perceived by both students and teachers as quite normal learning situations. Under these circumstances, mathematics teachers and tutors are often simply forced to use ICT, to create and develop new forms of organization of the educational process, to improve and adapt teaching methods and technologies accordingly.

Lately, we have heard many teachers' voices (see (Osvitoria, 2021a), (Osvitoria, 2021b)) that online learning *is at least as good as classroom learning*. In order to confirm or refute this hypothesis, we conducted a survey of mathematics teachers regarding their attitudes to the use of ICT in preparation for independent assessment and ways to use these technologies in their practice. We were also interested in the place and role of ICT in the process of finding the optimal model of preparation for the external examination in mathematics.

The aim of the article. In this article, we plan to: find out the feasibility of using ICT, as well as the place and role of technology in preparation for the EIA in mathematics from the standpoint of those who carry out this training (teachers, tutors, etc.); determine how modern technologies facilitate or hinder the search for optimal methods of preparation for independent testing in mathematics; outline ways to develop guidelines for the use of ICT in preparation for the EIA in mathematics.

MATERIALS AND METHODS

To achieve these aims we use the theoretical method of analysis of methodological literature on the research question. We also exploit some empirical methods: our own poll with help of Google form electronic tool, observation of the educational process in secondary schools and on the special exam preparation courses, as well as analysis of students' achievements. In this article we also use a set of methods of scientific knowledge: comparative analysis to clarify different views on the problem and determine areas of research; systematization and generalization in order to make conclusions and formulate recommendations to preparing for national standardized assessments of academic achievement in mathematics; generalization of the author's pedagogical experience and observations.

RESULTS

It is clear that there is no universal methodology of preparation for the external examination in mathematics, which would guarantee a high score for each test participant. Indeed, it significantly depends on the student audience and the individual characteristics of the teacher or tutor who accomplishes it. First of all, we should talk about a set of methods that will allow a modern mathematics teacher to achieve *the desired result*, which, in turn, depends on the *purpose of preparation* for the EIA. Let's dwell on this issue in more detail.

In our opinion, *independent assessment is only a tool* for adequate assessment of the level of student achievement, a kind of "ruler", which is designed only to "measure" and nothing more. It is also obvious to us that EIA in mathematics or any other subject *should not be the goal of schooling*. The main purpose of schooling is the development of the child, identifying and

disclosing his abilities, as well as the formation of those life competencies that will allow him in the future to find the place in life, to be realized as individuals. And independent testing, although is a classic "high-stakes testing" (more on this type of testing see in (Shkolnyi & Tykhonenko, 2021)), can not in itself become the ultimate goal or the teaching of each discipline, or even a guideline for creating a methodology for teaching.

Therefore, we believe that the main goal for the teacher in preparation for the external examination in mathematics is the repetition and systematization of data from the school course of mathematics, rather than formal training students to very specific classes of test tasks. Of course, it is necessary to adapt graduates to the peculiarities of solving test tasks of various forms (with alternatives, with a short answer, on matching, with a full explanation), but this goal is secondary and cannot displace or replace the main one. Methods of adaptation of students to specific test tasks can be found in the monograph (Shkolnyi, 2015), as well as, for example, in articles (Shkolnyi & Zakhariichenko, 2019), (Shkolnyi & Zakhariichenko, 2020a), (Shkolnyi & Zakhariichenko, 2020b) and others.

Also important in preparation for the EIA in mathematics is the goal set by the future participant of this test. At first glance, it is obvious that the student wants to score as many points as possible. However, such approach could have serious negative consequences in the future. In our opinion, it is more natural for students in preparation for external evaluation try to get not the maximum, but "their own" score, i.e. a score that will adequately reflect the real level of preparation and allow them to take "their own" place on the chosen specialty in the university. This goal setting will allow the graduate to avoid significant psychological problems in preparation for testing, as well as eventually find the specialty and the university that will allow him to become a realized and happy person (more about this see in the article (Shkolnyi, 2021)).

After agreeing on the goals of preparation for the EIA for the student and the teacher, the natural next step is to choose the appropriate methodology of systematization and repetition of the school mathematics. As already mentioned, this choice depends on many factors, but today, after more than 15 years of history, a set of such techniques has already been formed and reflected in various manuals for preparation for independent evaluation ((Bevz & Bukovska, 2020), (Halperina, 2020), (Kapinosov, 2020), (Nelin, 2016), (Rohanin, 2020), (Zakhariichenko et. al., 2020), (Zakhariichenko et. al., 2021)). Each of these books has its own internal logic, sequence of study of topics, its advantages and disadvantages. The critical analysis of these and other manuals will certainly be reflected in our subsequent publications.

The next step after choosing the appropriate methodology is the selection of teaching tools, as well as the choice of convenient for the student and teacher organizational forms of this training. Until 2020, traditionally the most popular tool in preparation for the external examination in mathematics is a printed textbook, and the most popular organizational forms is the group or individual lessons in the classroom. Various handouts were used as additional teaching aids, in particular, training thematic and combined tests containing tasks of various forms. Online training tests were also popular, in particular, tests of EIA of previous years.

However, due to the pandemic situation and the introduction of quarantine, after 2020 the situation has changed significantly, as classes in the classroom became impossible. Students and teachers had to, in fact, urgently master the means of distance communication (Google Meet, Skype, Zoom, etc.) and platforms for distance and blended learning (Google Classroom, MS Teams, MOODLE, NaUrok, etc.), with help of which, in particular, were carried out and control measures in the form of computer testing.

The described situation has led to significant changes in the perception of ICT by both students and teachers and tutors. This is confirmed by the results of the above-mentioned survey of the GIOS educational platform users (GIOS, 2021), among which 49% of respondents chose as the most optimal way to prepare for EIA in mathematics the way of training with tutor using printed manuals *and online platforms*. However, this survey did not delve into the details and features of the use of the latest technologies by teachers and tutors in preparation for the external examination in mathematics. Therefore, we conducted *our own survey of mathematics teachers* regarding their use of ICT in preparing students for independent assessment.

The survey was conducted anonymously and online using Google forms. The list of questions was as follows:

1. Do you prepare students for EIA in mathematics?
2. What format, on your opinion, is the most natural in training for EIA in mathematics?
3. Do you consider it appropriate to use e-learning tools in preparing students for EIA in mathematics?
4. What electronic tools should be used in classes with students in preparation for the external examination in mathematics?
5. Please share with us the names of electronic resources (or links to them) that you use in your classes in preparation for the EIA.
6. How useful do you find the use of electronic tools in preparation for the external examination in mathematics?
7. Do the available electronic resources and teaching aids satisfy your needs for organizing the preparation of students for the EIA in mathematics?

Here are *the results of this survey*. Among the respondents, more than 80% are directly involved in preparing students for the external examination in mathematics, the rest are indirectly involved in this process. Two thirds of respondents believe that the best way to prepare for the EIA today is *a combination of classroom classes and online format*. At the same time, almost a third believe that such training should be carried out exclusively in the classroom. Exclusively online format of preparation for testing is not popular from the standpoint of its effectiveness and efficiency. It can be assumed that the advantage in favor of the combined approach (classroom format & online classes) is a consequence of forced active development and practical application of blended learning during the last year. Accordingly, if under such conditions of work and study students will show no lower results than in the classical forms of work, then most likely, we will see an even higher percentage of supporters of the combined approach. However, the opposite situation is also possible, when the transition from classroom work to online will not justify its effectiveness in the eyes of its current supporters.

Note that 98% of respondents consider the use of ICT appropriate in preparation for the EIA in mathematics. The so-called "leader of using" of the latest technologies are online test platforms (about 80% of respondents). Moreover, this indicator

is approximately the same both among those who consider a more effective combined approach in training, and among those who believe more effective only classroom learning (see Figure 1 below). That is, online testing is actively used also during working in the classroom. Also, 45% of supporters of the classroom training format and 54% of those who choose a combined approach, consider it appropriate to use ICT in preparation for lessons.

It is interesting to note that the percentage of those who use ICT to communicate with students is more than three times higher among those who use a combined approach than among those who prefer purely classroom work. At the same time, the percentage of those who do not have the technical ability to use properly ICT opportunities is also three times higher among those who consider training in the classroom format is more effective. Thus, the commitment to the inclusion of the online format in the process of preparation for the EIA in mathematics is greatly influenced by the technical support of the teacher, in particular, in the context of the ability to communicate with the student without live meetings.

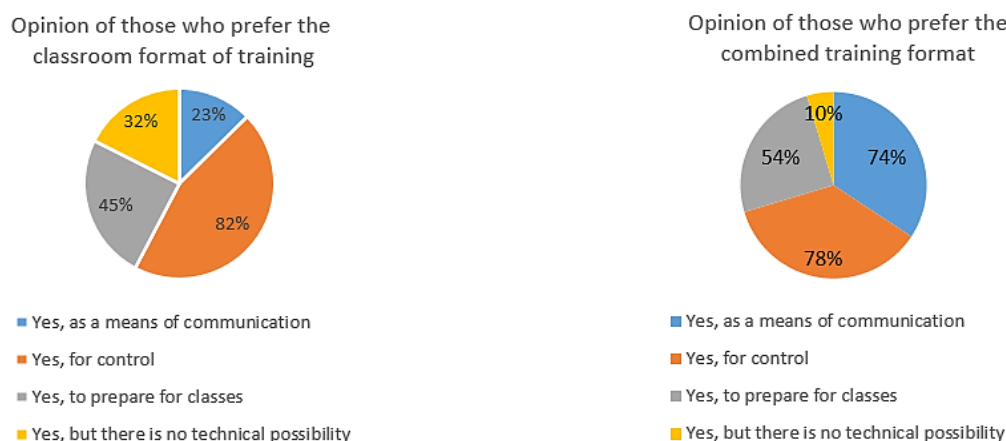


Fig. 1. Is it advisable to use ICT in preparation for the EIA in mathematics?

As Figure 2 below shows, among all the modern technologies used by mathematics teachers in preparation for EIA in mathematics, online test platforms are in the lead (they are used by almost 80% of respondents). However, the biggest problem with these platforms is the low level of peer-review and verification of their materials, as the vast majority of tests on these platforms are written by the teachers themselves. We do not discuss here their professional qualifications, but writing a qualitative test is not an easy task that requires special training. Therefore, we forced to state that, unfortunately, not all materials presented on popular Ukrainian online test platforms have a proper quality, and therefore, teachers should use of each such platform critically and with pedagogical balance.

After test platforms, electronic textbooks and video tutorials (more than 60% of respondents), as well as various application software (slightly less than 50% of respondents) are also very popular. It is interesting to note that math software in the classroom is used mainly by those who choose a combined approach or work online (64% of those who chose this item). Therefore, we can assume that using of this type of software is more convenient in online classes.

Among the specific electronic resources used in the work of survey participants, we note test platforms NaUrok (www.naurok.ua/student/tests), Osvita.ua (www.osvita.ua), Vseosvita (www.vseosvita.ua), Quizlet (www.quizlet.com) and Classtime (www.classtime.com), as well as sites with EIA tests of previous years (www.zno.osvita.ua/mathematics/). GeoGebra (www.geogebra.org), DG (www.dynamicgeometry.com) and GRAN (GRAN1, GRAN 2d and GRAN 3d, www.ktoi.fi.npu.edu.ua/zavantazhyty/category/1-gran1) dominate among the mathematical software. Among the answers there were also mentions of electronic boards for graphics tablets Idroo (www.idroo.com) and Awwap (www.awwap.com/home/).

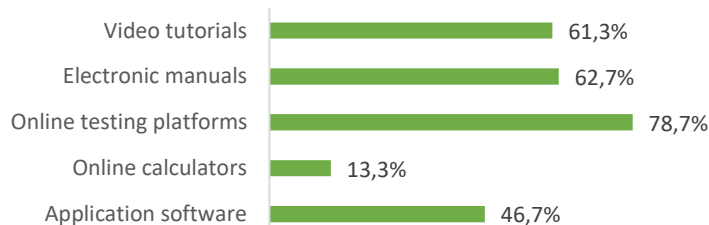


Fig. 2. E-tools in preparation for EIA in mathematics.

97% of respondents find the use of electronic tools in preparation for the EIA in mathematics useful, while the remaining 3% found it difficult to answer this question and assess the benefits of such resources. Thus, none of the respondents indicated that electronic resources can be harmful in preparing for an independent evaluation.

Regarding satisfaction with the availability and quality of electronic resources and teaching aids, the answers were distributed as follows (Figure 3):

Do the available electronic resources satisfy your needs in organizing the preparation for the EIA?

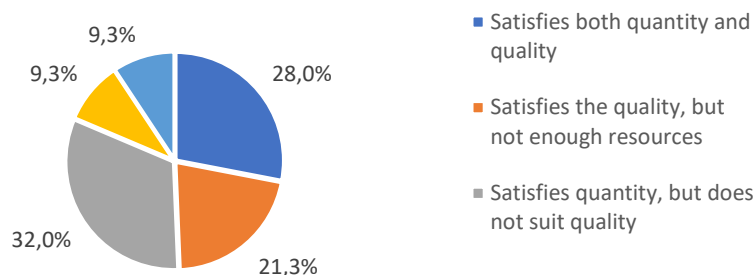


Fig. 3. Satisfaction with electronic resources.

As we can see, almost 30% of respondents are completely satisfied with the currently available electronic resources to prepare for the EIA in mathematics. This may indicate both a fairly good state of this area in our country (given the needs of users) and that the users of e-learning tools (in particular, to organize preparation for testing) have nothing to compare these tools and do not see possible ways to improve them.

More unexpected is the fact that almost half of the respondents (49%) are satisfied with the quality of available resources. Given the popularity of online test platforms on the one hand and the uncontrollability of their content on the other, this is controversial. Of course, we can assume that our respondents either use these platforms to create their own qualitative tests, or are experienced in choosing the tests with proper quality from those offered. However, the availability of freely available tests of questionable quality, which teachers can use in their practice, or even students can find in self-study, is of great concern.

Note that there are no categorically dissatisfied with the current state of available electronic resources among survey participants. This leads to the conclusion that this market is quite full, including quality products, among which everyone can find something useful and convenient for their activities. At the same time, 72% of respondents are not completely satisfied with the current state of the electronic resources market, which indicates the need to develop and improve this area.

CONCLUSIONS AND PROSPECTS FOR FURTHER RESEARCH

In our opinion, the most important thing for both the teacher and the student in preparation for the EIA in mathematics is to ensure the proper quality of systematization of the school mathematics course, rather than formal training for solving of specific classes of test tasks. It is extremely important for teachers and students to understand the need not to get the maximum possible score in any way during testing, but to determine their real level of mathematical preparation. This will contribute to the further successful education of the graduate at the university and his (her) future implementation both as a specialist and as a person.

Of course, this does not mean that the level of mathematical preparation of a student cannot increase during the training for the external evaluation. On the contrary, any method of preparation for testing aims to mobilize all possible internal resources of the graduate to successfully pass this test. However, the main emphasis should be on the development of thinking and broadening horizons, not on the formal memorization of definitions, statements and typical methods of solving exercises and problems.

It is desirable that a mathematics teacher has not one defined methodology of systematization and repetition of school mathematics during preparation for EIA, but a set of methodologies that would allow him to respond flexibly to the peculiarities of the student audience and meet his (her) own professional aptitudes and preferences. The appropriate use of ICT in this set of methodologies of preparation for EIA is natural in itself and in the context of the pandemic and quarantine situation of recent months. In this regard, it is important to properly train teachers to use the latest technologies both during their studies at the Pedagogical University and in the system of their continuing education.

According to our survey of mathematics teachers who prepare students for independent assessment, the most optimal ways of such training they consider either special training with a tutor using printed manuals and online platforms, or systematic proper schooling, which does not require additional training. In both cases, according to the respondents, it is better to conduct classes either only in the classroom, or to combine classroom classes with online classes. Only distance training, according to respondents, does not provide the desired result. This opinion of teachers is natural, because they have almost no experience of online classes in preparation for external evaluation. It would be interesting to conduct a similar poll of the same teachers in a few years, when the use of distance and blended learning technologies will become commonplace. We are convinced that this sector of Ukrainian mathematical education has great prospects for development.

It is also natural for most teachers surveyed to think that ICT is best used to prepare for classes and realization of control. At the same time, the dominance of online test platforms among e-learning tools is due to both accessibility to the general public and ease of mastering them. In the process of teaching mathematics and in preparation for EIA, the latest technologies are used much less often, because their use requires fundamentally new teaching methods, which are still under development and formation. Based on the data of teachers' surveys, we believe that the use of electronic tools in preparation for the external examination in mathematics is useful, but the quantity or quality of currently available resources does not fully satisfy the majority of users. Given the popularity and demand for online test platforms, it is important to ensure the proper quality of the tests offered to all users.

We emphasize that in order for math teachers to be able to distinguish qualitative electronic tools from mediocre ones, as well as to select or create appropriate content for online test platforms, it is necessary to carry out their systematic training. Masters of educational programs in the specialty "Secondary education (mathematics)" in National Dragomanov Pedagogical University studies specialized courses dedicated to this problem, such as "Computer-oriented systems of teaching mathematics", "Monitoring of academic achievements in mathematics of pupils and students", "Methods of test tasks creating". These courses allow students to be at least competent users of the latest teaching aids in mathematics, and in some cases to develop or improve these tools.

We are already partially implementing the content of these courses to the entire Ukrainian audience of mathematics teachers. One of the authors of this article systematically conducts training seminars for mathematics teachers in different regions of Ukraine, dedicated to the methods of preparation for external examination. However, in our opinion, these efforts are not enough. A systematic educational program is needed to create publicly available methodological materials on various methods of preparation for EIA in mathematics, including the use of ICT. This program, in particular, can be implemented through a network of centers and training platforms such as Osvitoria, Osvita.ua, Vseosvita, NaUrok, GIOS and others, as well as through a network of in-service teacher training centers, including online platforms such as Prometheus (www.prometheus.org.ua), Edera (www.ed-era.com), Coursera (www.coursera.org), Khan Academy (www.khanacademy.org), EdX (www.edx.org), etc. In the future, we plan to develop such training materials and place them on these resources.

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ЗАТОСУВАННЯ ІКТ ПІД ЧАС ПІДГОТОВКИ ДО ЗНО: ШЛЯХИ ПОШУКУ ОПТИМАЛЬНОЇ МОДЕЛІ

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Анотація.

Формулювання проблеми. Актуальність вдосконалення методики підготовки до ЗНО з математики наразі сумнівів не викликає. Раніше нами було встановлено, що електронні засоби при підготовці до ЗНО з математики є малопопулярними серед абітурієнтів, але позитивні тенденції в розвитку ІКТ для підготовки до ЗНО з математики також присутні. Потужною мотивацією до використання технологій під час навчання математики стала нинішня пандемічна ситуація, коли введення карантинів і тривалі періоди навчання онлайн починають сприйматися учнями і вчителями як звичайні навчальні ситуації. За цих обставин вчителі математики вимушені використовувати ІКТ, створювати і розробляти нові форми організації навчального процесу, вдосконалювати та адаптувати методики і технології навчання. Метою даної статті є встановлення доцільності використання ІКТ, їх місця і ролі під час підготовки до ЗНО з математики з позиції вчителів та репетиторів, а також визначення, яким чином сучасні технології сприяють чи заважають пошуку оптимальної методики підготовки до цього виду оцінювання.

Матеріали і методи. Для досягнення цілей статті ми застосовуємо емпіричні методи: власне опитування за допомогою електронного засобу (Google forms), спостереження за навчальним процесом учнів, а також аналіз результатів їхніх досягнень. У дослідженні використано комплекс методів наукового пізнання: порівняльний аналіз для з'ясування різних поглядів на проблему; систематизація та узагальнення для формулювання висновків і методичних порад; узагальнення авторського педагогічного досвіду і спостережень.

Результати. Як показало наше опитування вчителів математики, дві третини з них вважають, що найбільш оптимальним способом здійснення підготовки до ЗНО є поєднання аудиторних занять і онлайн-формату. 98% опитаних вважає використання ІКТ доцільним при підготовці до ЗНО, причому лідером серед цих технологій є тестові онлайн-платформи (НаУрок, osvita.ua, Всеосвіта, Quizlet, Classtime). 97% респондентів вважають використання електронних засобів при підготовці до ЗНО з математики корисним, а 28% повністю задоволені і кількістю, і якістю наявних електронних ресурсів. Водночас, 72% вчителів вважають, що кількість електронних засобів навчання слід збільшити, а їх якість слід покращити, що говорить про необхідність розвитку та вдосконалення даної сфери.

Висновки. Універсальної методики підготовки до ЗНО з математики не існує, оскільки вона суттєво залежить як від учнівської аудиторії, так і від індивідуальних особливостей вчителя чи репетитора, котрий її здійснює. Незалежне оцінювання є лише інструментом для адекватного оцінювання рівня навчальних досягнень учня і не може бути метою навчання в школі. Натомість головною метою навчання є розвиток дитини, розкриття її здібностей, а також формування тих компетентностей, які дозволять їй знайти своє місце в житті, реалізуватися як особистості. Тому при підготовці до ЗНО з математики головною метою для вчителя ми вважаємо повторення і систематизацію шкільного курсу математики, а не формальне тренування учнів розв'язувати конкретні класи тестових завдань. Використання ІКТ при цьому сприймається нами як природне доповнення навчального процесу, а не лише як вимушений крок внаслідок навчання в умовах карантину. Ми вважаємо, що використання електронних засобів при підготовці до ЗНО з математики є корисним, але при цьому важливим є забезпечення належної якості тестів, що пропонуються до загального доступу вчителям і учням на різноманітних онлайн платформах.

Ключові слова. ЗНО і ДПА з математики, інформаційно-комунікаційні технології, електронні засоби навчання.

