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Educational Issues
Въпроси на преподаването

TEACHING MATHEMATICS UNDER EXTREME CONDITION: UKRAINIAN REALITIES AND EXPERIENCE

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Abstract. Since February 2022, Ukrainian education has been in extreme conditions of martial law. In this article, we analyze Ukrainian realities and experience in ensuring mathematical training of students in extreme conditions of martial law in the country. How do Ukrainian schools, teachers, and students work in wartime conditions? How is school mathematical education being restored and is it being restored in communities affected by the war? The acquired Ukrainian experience in organizing educational processes in such conditions is relevant against the background of increasing international interest in new extreme challenges.

Research methods: observations, conversations, interviews with teachers, students, parents of students, analysis of documents of the Ministry of Education and Science of Ukraine, analysis of current publications in the Ukrainian information space.

The article identifies and characterizes three special periods of the organization of educational processes: from February 24, 2022 – until the end of the 2021 – 2022 academic year; 2022 – 2023 academic year; 2023 – 2024 academic year.

Each of the specified periods has its own characteristics of education. For each of the specified periods, the conditions of martial law and the corresponding actions of the Ministry of Education and Science of Ukraine, the activities of mathematics teachers and the activities of students are characterized. The main challenges (power outages, limited access to distance learning tools, air raids, lack of shelters) faced by Ukrainian students and teachers are considered. The state of organization of distance and blended learning in mathematics is described, and the problems that arise during its organization are outlined. Specific examples of organizing mathematics teaching in wartime and using interactive techniques that promote students' emotional resilience and support their motivation to learn are provided.

Our general conclusions, which may be useful for other countries in crisis situations: the activities of all those involved in education in new extreme conditions must be clearly adjusted; the efficiency and balance of management documents are important; it is important to treat the difficulties of students in

extreme learning conditions with increased attention and understanding; it is necessary to establish interaction and mutual support among teachers to find and implement new forms and means of learning in extreme conditions; methodologists, through various seminars and webinars, can help increase the ability of mathematics teachers to work effectively in extreme conditions.

Keywords: distance and blended learning; mathematics education; extreme learning conditions; wartime learning strategies

1. Introduction

1.1. The problem formulation

In 2019-2021, educational processes in the world suffered from the extreme conditions of the COVID-19 pandemic. Even after the easing of the quarantine, it became clear for Ukrainian mathematics education that humanity has entered a new stage of development, where distance and blended learning will play a significant role. Since February 2022, Ukrainian education has been under extremely difficult conditions of martial law. The war led to the emergence of issues of access and security of education. Many children lost the opportunity to participate in the educational process, teachers taught under the threat of shelling in regions where hostilities were or could potentially be. Such events required and currently require serious planning of educational processes and provision of proper conditions for learning in extreme conditions. However, other countries are also currently under the threat of natural disasters, military conflicts that arise in different parts of the world. Therefore, the analysis of the experience of organizing educational processes in extreme conditions is currently relevant for pedagogical science at the international level.

Analysis of recent research and publications

Ukrainian mathematical education has deep roots and traditions. You can learn more about its development from the section of the monograph (Shvets et. al. 2020). If we talk about the present, the most urgent and painful problems of mathematics education in Ukraine is adaptation to the current extreme living conditions. In these conditions, teachers are faced with the emotional instability of students during learning, caused by external factors. Other experts in the field of mathematics education are also paying attention to this problem.

Constantinos Xenofontos and Stella Mouroutsou note (Xenofontos & Mouroutsou 2023), based on the results of their own research, that in the last 11 years, almost three times more articles have been published investigating the problems of emotional stability in mathematics education than in the previous 39 years. This modern observation of these researchers indicates an increase in international interest in new topical problems in the organization of mathematics education.

In February 2021, the CERME International Forum organized by the European Society for Research in Mathematics Education took place in London. The ERME Forum hosted a panel discussion (Matiash et. al. 2022) on "Mathematics Education During and Beyond the COVID-19 Pandemic: Challenges and Opportunities for Mathematics Education". Panelists Mario Sanchez Aguilar (Mexico), Merrilyn Huss (Ireland), Kristina Sabena (Italy) and Yvette Solomon (Norway/Great Britain) argued the challenges of the pandemic for education and their own vision of the possibilities of mathematics education, the possibilities of information technologies in extreme conditions. In particular, Kristina Sabena (Italy), a member of the editorial board of the journal "Educational Studies in Mathematics" focused attention on the characteristics of the topics of the articles in the last 2020 issue of this journal. Kristina Sabena noted that the authors of the articles most often investigate problems related to the remote practice of teaching mathematics at school. In particular, the possibilities and features of transferring effective methods and techniques of teaching mathematics from the classroom to virtual classrooms (spaces) are studied. Kristina Sabena also reported that the journal's editorial board is ready to publish substantiation of researchers' ideas about what new methods can be developed for distance learning of mathematics online. At the end of her speech, Kristina Sabena informed that a special issue of ESM magazine is being prepared – "Mathematics education during the crisis virus pandemic". Mario Sanchez Aguilar (Mexico) noted in his speech that society expects from us answers to new questions and specific advice for mathematics teachers: What approaches to teaching mathematics "work" in the Internet? How can people with limited or no access to digital technologies receive mathematical education today? What mathematical competencies should be developed to prepare citizens to interpret information in emergency scenarios? Mario Sanchez Aguilar identified the

search for scientifically based answers to these questions as new opportunities for expanding research in the field of mathematics education.

Thus, the conditions of the COVID-19 pandemic have focused the attention of mathematics education researchers around the world on the problems of: distance and blended learning of mathematics students; development of tools, platforms and teaching techniques for online mathematics learning. We have indicated the panel discussion of the International CERME Forum, the speeches of the speakers of the discussion are important for our study, as they provide us with arguments to argue that our Ukrainian experience in ensuring mathematical training of students in extreme conditions (in our case, in conditions of war) can be valuable for the global pedagogical community. In this article, we aim to show: How do segments of the population with limited access to digital technologies, or without it, currently receive mathematical education? The search for answers to this question was recognized by the speakers of the panel discussion of the International CERME Forum as new opportunities for expanding research in the field of mathematics education.

The purpose of the article is to consider the Ukrainian realities and the experience of teaching mathematics under the extreme conditions of martial law in the country.

2. Theoretical basis of research

Since March 2020, in connection with the spread of the COVID-19 virus, a general quarantine was introduced on the territory of Ukraine, which significantly changed the course of educational processes. Long-term self-isolation forced both teachers and students to look for new forms of teaching and learning. The fact that the quarantine was introduced forced teachers to intensify their work in the direction of distance learning. At the beginning of September 2020, the Ministry of Education and Science of Ukraine approved the mechanism for ensuring the acquisition of complete general secondary education by distance form by the Order "Some issues of the organization of distance learning"[1]. In particular, this Order explained certain key concepts:

– *distance learning* – the organization of the educational process in conditions of remoteness of its participants from each other and their, as

a rule, mediated interaction in an educational environment that functions on the basis of modern educational, information and communication (digital) technologies;

– *asynchronous mode* – interaction between subjects of distance learning, during which participants interact with each other with a time delay, while using interactive educational platforms, e-mail, forums, social networks, etc.;

– *synchronous mode* – interaction between subjects of distance learning, during which participants are simultaneously in an electronic educational environment or communicate using audio and video conferencing;

– *electronic educational environment* – a set of conditions for learning, education and development of students, provided with the help of modern educational, information and communication (digital) technologies;

– *distance learning technologies* – a complex of educational and information and communication (digital) technologies that make it possible to implement the process of distance learning in educational institutions.

According to the specified Order, the organization of the educational process was supposed to ensure regular and meaningful interaction of subjects of distance education, using forms of individual and collective educational and cognitive activity of students, as well as their self-control during education. Teachers had the opportunity to independently determine the mode (synchronous or asynchronous) of conducting individual classes. At the same time, at least 30 percent of the study time provided by the educational program of the educational institution had to be organized in a synchronous mode (the rest of the study time was organized in an asynchronous mode).

In the above-mentioned Order "Some issues of the organization of distance education", certain provisions related to unexpected extraordinary circumstances. For example, "during extraordinary circumstances, the amount of training time provided in synchronous mode is determined by the pedagogical worker and may be less than 30 percent of the training time"[1].

Since February 24, 2022, such extraordinary circumstances have dramatically changed the lives of all Ukrainians. Education in all schools and universities of the country had been stopped.

3. Methodology of research

From March 2020 to February 2022 (quarantine), from February 2022 to the present time (martial law in the country), both the MES of Ukraine, teachers of Ukrainian schools, and teachers of higher education institutions (universities) are searched for answers to the question: "How to improve the educational process?", "How to ensure the effectiveness of forced distance learning?", "How to optimize the educational process in extreme conditions?", "Which online resources should be preferred?" etc.

Our retrospective analysis of the conditions and realities of teaching mathematics in Ukraine during the armed aggression of the Russian Federation, we present, for the convenience and completeness of the information, as a description of three periods that, in our opinion, are special for Ukrainian mathematics education:

– from February 24, 2022 – until the end of the 2021-2022 academic year;

– 2022 – 2023 academic year;

– 2023 – 2024 academic year.

Each of the specified periods has its own peculiarities of study conditions, peculiarities of the organization of activities of those involved in educational processes in Ukraine. For each specified period, we characterize the activities of the Ministry of Education and Science of Ukraine, the activities of mathematics teachers, and the activities of students.

The activities of the MES of Ukraine, in the extreme conditions of war, are characterized by us on the basis of the analysis of key documents issued by the MES in the indicated periods – MES Orders and MES Letters[2,3,4,5]. The activities of mathematics teachers and the activities of students, in the extreme conditions of war, are characterized by us on the basis of our own observations, conversations, interviews with teachers, students, parents of students and on the analysis of relevant publications in the Ukrainian information space.

4. Results of research

4.1. From February 2022 to June 2022

First, let's consider the period from February 24, 2022 to the end of the 2021-2022 academic year (June 2022).

For almost two weeks from February 24, 2022, educational processes in Ukraine were stopped. The main thing was the preservation of life and the protection of the country. On March 6, 2022, the Letter of the MES of Ukraine "On the organization of the educational process" appeared (MES of Ukraine, 2022a), in which, for the sake of the safety of the participants of the educational process, a forced vacation was announced until March 13. After March 13, the MES of Ukraine recommended the resumption of education in educational institutions in a distance format. It was recommended to actively use available electronic resources, primarily the All-Ukrainian Online School, regional platforms, resources of educational institutions, including private ones, which were previously informed by the MES of Ukraine.

The "All-Ukrainian School Online" platform is a modern online resource for distance and blended learning of students in grades 5-11 with lessons and methodological materials that correspond to the state program. The educational content of the platform includes lessons in 18 main subjects: Ukrainian language, Ukrainian literature, biology, biology and ecology, geography, world history, history of Ukraine, mathematics, algebra, algebra and beginnings of analysis, geometry, art, basics of law, natural science, physics, chemistry, English language and foreign literature. It is important that the platform provides access to educational content in Ukrainian for children and teachers living in the temporarily occupied territories of Ukraine. And also for children who are abroad and want to study according to the Ukrainian state program.

In the Letter of the Ministry of Education and Science of Ukraine "On the organization of the educational process" it is recommended to use the following means of communication: posting tasks and recommendations on the institution's website; creation of groups with parents, students in social networks (Viber, Telegram, WhatsApp, etc.); use of electronic platforms (ZOOM, Google Classroom, etc.); conducting Skype conferences; communication in telephone mode; correspondence via e-mail, etc.

In order to find out the state of the organization of distance learning of mathematics in the specified period, to study the problems that arose during its organization, our colleagues from the Institute of Pedagogy of the National Academy of Sciences of Ukraine (Burda & Vasylyeva 2022) conducted a survey of about 550 mathematics teachers and 560 students in the 2nd semester of the 2021/2022 academic year from 24 regions of Ukraine. As the survey showed, about 90% of teachers still managed to organize distance learning of mathematics in the second semester of the 2021/2022 academic year (during the war). About 45% of teachers were able to organize the format of synchronous learning, 51.6% – bichronous learning (a combination of synchronous and asynchronous learning) and only 3.3% of mathematics teachers organized only asynchronous learning of mathematics for their students. The number of synchronous lessons in most teachers (62.3%) coincided with the weekly workload, and in 34.3% it was less. 79% of teachers noted that the duration of their synchronous lessons ranged from 30 to 40 minutes. Most often, teachers used the following services:

– for video communication with students, Zoom (46.5%) or Google Meet (60%);

– for the formation of competences and control Na Urok (79.4%), Vseosvita (76%), Learning Apps (51.9%), All-Ukrainian School Online (50%), My Class (27.7%), Classtime (18.4%), GIOS (12.2%), Matific (12%), etc.

More than 92% of teachers used multimedia content in education (75.9% created their own materials on various resources, 67% used ready-made developments). The older the students were, the more often teachers offered them to take lessons independently on various platforms, including the AllUkrainian School Online. 75% of mathematics teachers noted that they included exercises to stabilize students' emotional state in their lessons (20% of them did it systematically). According to the results of training, 87.6% of teachers checked students' learning of educational material, 60% of teachers did not fall behind the program, and 54.3% had time left to repeat the material. 51% of teachers noted that it was most difficult to organize distance learning in grades 7^{th} – 9^{th}.

These are the results of the teachers' survey. What did the student survey show?

First, 50% of students in grades 5^{th} – 9^{th} and 35% of students in grades 10-11 noted that they like attending synchronous mathematics lessons because it helps to distract from the events taking place in Ukraine, 50% of students of all age groups noted that they like synchronous online lessons because they allow them to communicate with classmates and the teacher. 15% of students claimed that they do not like synchronous lessons only because of the low quality of the Internet. According to the survey, 50% of students in grades 7^{th} – 11^{th} did not miss synchronous online math lessons offered by the teacher, and in grades 5-6 this indicator increases to 64%.

Students note that their motivation has decreased (30% of students in grades 5^{th} – 6^{th}, 40% of students in grades 7^{th} – 9^{th}, 50% of students in grades 10^{th} – 11^{th}) and self-efficacy (40% of students in grades 5^{th} – 6^{th}, 50% of students in grades 7^{th} – 9^{th} grades, 70% of students in grades 10^{th} – 11^{th}). The teachers noted that they also noticed changes in the students' behavior. 53% of teachers believe that students' responsibility has decreased, 44.7% have noted that students' motivation has worsened, 41.2% have noted that attention and concentration have decreased, and 34.4% have noticed a deterioration in memorizing material. In each grade there were students who did not study in the 2nd semester of 2022 (in grades 5^{th} – 6^{th}, this is approximately 18% of students in the class, in grades 7^{th} – 9^{th} – 24%, in grades 10^{th} – 11^{th} – 21%).

Also, during the survey, it was found that an average of 19.4% of students in grades 5^{th} – 11^{th} have gone abroad, and 7% have already decided that they will not return to Ukraine.

4.2. Academic year 2022 – 2023

Next, let's consider the conditions and realities of teaching mathematics in Ukraine in the 2022-2023 academic year.

Ukraine began the 2022/2023 academic year while being in the active phase of the war. Some of the institutions (which have bomb shelters) opened for face-to-face or blended leaning, while the other part continued to organize distance learning. It is worth noting that there may not be enough space in the shelters for all the students of the educational institution, and then training may take place in two shifts or in a mixed format (for example: certain classes go to face-to-face learning, and some remain in distance learning, or there may be an alternation of learning

formats in all classes). Parents were given the opportunity to choose the form of education: 1) traditional; 2) distance; 3) family (see MES of Ukraine, 2022b).

In the family form of education, students study at home independently under the guidance of their parents, but they write test papers several times a year. The family form of education turned out to be convenient for students of the 11th (graduating) grade, who, preparing for the External Independent Assessment of Educational Achievements, focus on individual subjects and often study with tutors, including mathematics. The main problem in the organization of training in the vast majority of the Ukrainian territory in the specified period was frequent alarm signals and significant power outages, especially in the autumn-winter period. Due to Russian shelling, emergency power outages were regularly applied throughout the territory of Ukraine from October to March 2022/2023 academic year.

The conditions in which all the participants of the educational process were and the constant emotional stress determined the specificity of face-to-face, distance and blended learning of mathematics at this stage of the martial law in the country. The number of students who did not have access to distance learning gadgets or the Internet increased dramatically. At that time, there were institutions where a teacher could conduct the same lesson twice (for example, in the morning for students who came to school, and in the afternoon for those who study remotely). Most students were anxious or stressed.

How did teachers cope with this? We recorded several interviews with mathematics teachers, based on which we can assert that in the extremely difficult conditions of war, Ukrainian teachers sought and found opportunities to organize students' learning. We saw this in real observations of the organization of school learning activities, and also found relevant posts by teachers in pedagogical publications.

Let's give a specific example of a math teacher's story. This is a post by Nataliya Chernomaz (Chernomaz 2022), a math teacher in one of the regions closest to the active fighting (Chuhguiv district of the Kharkiv region):

The teaching format at the lyceum is somewhat non-standard, but effective. Lessons are conducted using the Zoom online platform.

Mathematics lessons are held in bichronous format. Depending on the situation, synchronous (92%) or asynchronous training is organized. The beginning of the lesson is devoted to the emotional mood of students: emotional posters – pictures consisting of an image and an inscription commenting on it (smileys) and virtual hugs.

Having stabilized the emotional component, I actively switch the children's attention to the lesson. To make the actualization of basic knowledge interesting, I use the LearningApps application (I create interactive exercises). With the help of this program, I create the following tasks: find a pair, crosswords, classification, simple arrangement, image fragments, fill in the blanks, "Guess the word" puzzle, "Guess the pairs" game. I visualize all educational terminology, personally created presentations, videos, graphic editors help me in this. Thanks to the platforms "Vseosvita", "Na Urok", the online tool Kahoot, I create tests, independent works, or use ready-made developments to check students' understanding of the educational material. Timely posted grades and comments on them in the online diary help to increase students' responsibility and their motivational qualities. In our lyceum, we practice the "New knowledge" platform.

At the end of the school day, I fill out an electronic journal, to which parents and students have personal access. I am deeply convinced that information technologies and software tools contribute to the coordinated organization of the online process during martial law. Although online education does not replace full-fledged offline lessons, in modern realities it is an effective alternative to them.

So, in general, it can be said that Ukrainian mathematics teachers showed resilience and courage, trying not to lose the quality of students' mathematical education in extremely difficult conditions. On the state level, the educational reforms started before the war have not been stopped either. In particular, despite the forced pause in 2022, new steps have been taken in the implementation of the Concept of a New Ukrainian School (Burda & Vasylyeva 2022). Funds for the pilot seventh grades of NUS have been earmarked for the purchase of teaching aids and teaching-methodical literature, multimedia and computer equipment, and furniture. The government managed to find funds to partially cover the need for mathematics textbooks. Restoring the reform

of the National Academy of Sciences in the conditions of war is a challenge for the MES of Ukraine and the entire educational community.

4.3. Academic year 2023 – 2024

Finally, let's consider the conditions and realities of teaching mathematics in Ukraine in the 2023 – 2024 academic year.

At the beginning of the academic year 2023 – 2024, the problem of power outages disappeared in Ukraine. The main problem in the organization of training in the vast majority of Ukrainian territory has become frequent alarms that notify of a threat to life. During the specified academic year, Russia's aggressive attacks led to significant destruction of the Ukrainian energy system, therefore, in the summer of 2024, electricity blackout schedules were again implemented throughout Ukraine.

As of the beginning of the 2023 – 2024 academic year, 3793 educational institutions in Ukraine were damaged by bombings and shelling, and 365 educational institutions were completely destroyed. As of September 2023, almost 13000 schools are operating in Ukraine, of which more than 80% are already equipped with shelters. According to the Ministry of Education and Science of Ukraine, about 7500 schools work in a face-to-face format, 38000 work in a mixed format, and 2500 schools teach exclusively remotely.

In November 2023, the MES of Ukraine had sent a letter to all educational institutions, which specifically states (MES of Ukraine, 2023):

– We emphasize that in the conditions of martial law, one of the priority tasks of the state is to preserve the life and health of its citizens, especially children, and to ensure their access to education.

– Educational process in institutions of general secondary education in 2023/2024 academic year, in accordance with the decisions of the regional and Kyiv city military administrations and the founders of educational institutions, can be organized by face-to-face, distance learning forms or their combination (under a mixed mode) depending on the capabilities of the fund of protective structures of these institutions.

– When organizing the educational process, regardless of the selected form (face-to-face, distance or blended mode), in case of activation of

the "Air alarm" signal or other warning signals, it is necessary to ensure unconditional interruption of learning. The participants of the educational process should proceed in an organized manner to the civil defense facilities and stay there until the alarm will be stopped, if possible continuing their learning in shelter.

In the context of the military operations currently taking place on the territory of Ukraine, we observe significant differences in the educational opportunities of all participants in the educational process, which lead to certain specifics of the organization of mathematics education during the war:

– periodic lack of training in certain territories (these are territories of active hostilities);

– periodic or permanent absence of part of the students in the class, classes are not static groups, but dynamic;

– frequent technical problems (lack of electricity, lack of or insufficient number of gadgets or the Internet);

– poor health of both students and teachers (stress, possible problems with food, water, fresh air, limited movement, sunlight, difficult emotional state, etc.);

– significantly reduced motivation, self-organization and self-efficacy of all participants in the educational process;

– limited time opportunities for creating content for the lesson by teachers and completing homework by students;

– different conditions in which students are (staying at home, internally displaced, externally displaced), which lead to different feelings of security and opportunities for learning.

Currently, there is a demand for synchronous online lessons from some students, because such lessons help to distract from the events taking place on the territory of Ukraine, and also provide an opportunity to communicate with classmates and teachers. The need for offline learning is increasingly expressed by students, teachers, and parents. Psychologists, methodologists, various educational public organizations are trying to help mathematics teachers overcome difficulties in the organization of education during the war with the help of various seminars, webinars, and various types of training. Let's give an example of one of such projects, the implementation of which involved the

departments of the universities where we, the authors of this article, work.

A large-scale project called "Let's catch up: courses on overcoming educational losses" started in Ukraine in September 2023. This project is implemented by the public union Osvitoria[6] in partnership with the MES of Ukraine, with the United Nations Children's Fund (UNICEF) with the support of the Global Partnership in Education (GPE) and the Government of Japan.

The project "Let's catch up: courses on overcoming educational losses" is designed to provide teachers with the necessary knowledge and practical tools to improve the knowledge of students in elementary school – in reading, writing, mathematics, and in secondary school – in Ukrainian language and literature, mathematics.

The project "Let's catch up: courses on overcoming educational losses" envisages a cascade model of implementation: first, the selection and training of trainers, then their training of teachers offline in the regions, as well as online courses that are available to every Ukrainian educator. This project provides for the special training of certified course trainers who will later work with groups of teachers, particularly mathematicians. The training includes discussions with mathematics teachers on 8 key topics:

– Monitoring educational losses: what are we diagnosing?

– Strategies for overcoming educational losses in mathematics.

– Student motivation as an important factor in overcoming educational losses.

– Stabilization of students' emotional state related to mathematics. Organization of training in a shelter.

– Task-based approach in mathematics lessons.

– Formative assessment.

– Use of diagnostic tests on the All-Ukrainian School Online platform. Creating your tests.

– DESMOS for the organization of cooperative learning in the context of overcoming educational losses.

During the training, the state of educational losses in Ukraine is actively discussed with teachers. Teachers unite in dynamic groups and perform a number of different tasks, presenting their own ideas and

exchanging experiences of effective teaching of mathematics in extreme conditions. This form of business game provides an opportunity to hear different approaches, understand the rationale and find common solutions that can be used to overcome common problems. As our observations show, each of the teachers understands the importance of unity during the difficult trials of war, the importance of sharing our methodical findings. Thus, the trainings described above are not formal lectures, but active interaction between participants. The most active discussions were about the motivation of teaching mathematics during the war, about the convenience of interactive platforms in teaching mathematics, about ways of creation of success situations for students, and about preserving mental health.

Summarizing, we note that currently in Ukraine there is a sharp shortage of mathematics teachers. This problem was brewing even before the war (Matiash et.al. 2021). However, nowadays it has sharply worsened, because some teachers have gone abroad, some teachers of retirement age have left their jobs under conditions of constant stress and technologically new conditions of the organization of education. Currently, students of pedagogical universities are massively working as mathematics teachers in schools in parallel with distance learning at the university. The demand for such young teachers is huge now, because they have a better command of digital learning technologies, and are faster to adapt to extraordinary conditions.

5. Conclusions

In this study, we tried to find answers to the questions of how Ukrainian schools, teachers, and students work in war conditions, how and whether school mathematics education is being restored in communities affected by the war.

Summarizing the characteristics of the realities of teaching mathematics in Ukraine during the armed aggression of the Russian Federation, we note that Ukrainian mathematics teachers and students rather quickly adapt to extreme conditions, persistently overcome difficulties: they live, work and study in extremely cruel conditions of war. Emotional support in mathematics learning under extreme conditions refers to the ability of mathematics teachers to create a warm and respectful classroom climate by promoting positive teacher-student

and student-student interactions. It is important to treat difficulties in extreme learning conditions with increased attention and understanding, supporting the social and emotional moods both students and teachers.

As for ensuring the quality of mathematics education, an important role is played here by the efficiency and balance of management documents (MES Letters, MES Resolutions), which should clearly adjust the activities of all those involved in education in new extreme conditions. We should also not underestimate the need to establish interaction and mutual support among mathematics teachers to find and implement new means and methods of teaching mathematics that can ensure the quality of mathematical training of students in the face of new challenges, in extreme conditions.

We see the prospects for further research in a more in-depth analysis of specific means and methods of teaching mathematics, which allow Ukrainian mathematics teachers to ensure the quality of teaching mathematics under extreme conditions of the martial law.

6. Research limitations

The study covers a period of three years, which may not fully reflect the long-term effects of wartime conditions on the educational process. Due to the complex circumstances of wartime, teachers and students are involved in the study in a fragmented manner, which affected the representativeness of the sample. The situation during wartime is dynamic, which affects the changing conditions of the study, the collected data, and their relevance.

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