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Organization and conduct of classes in educational institutions during distance learning

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Abstract. The article considers the use of cloud technologies during distance learning. The implementation of the mechanism of distance learning in general secondary education in two areas is described: distance form as a separate form of education and the use of distance learning technologies in the organization of education in various forms (day, evening, correspondence, etc.). The software for the organization of distance learning of pupils and students is listed. Examples of development of own electronic educational materials for teaching mathematics and computer science are given.

1. Introduction

Because of the spread of the new coronavirus in many countries, was officially announced quarantine and closed schools. Among such countries was Ukraine, where quarantine was established for an indefinite period for the first time.

Pupils and students began to study all disciplines remotely. The administration of general secondary education institutions and the management of higher education institutions urgently developed programs, selected platforms and tools for the implementation of distance learning [8].

Prior to that, the topics that fell during the quarantine were studied in schools by consolidating the educational material. In this case, it was useless to count on such. Therefore, the teaching of pupils and students was carried out using various distance technologies and platforms, which were mastered and available to teachers and lecturers. Pupils and students had not only to study disciplines in new conditions, but also to learn to work with new services and programs.

Due to the difficult epidemiological situation and the urgent need to regulate the provisions of distance learning, the Ministry of Education and Science of Ukraine submitted for discussion the “Draft Regulation on the distance form of general secondary education.”

Schools in most countries around the world, realizing the growing trend of patients, are gradually switching to computer-based learning systems and using online learning platforms.

2. Theoretical background

The issue of widespread use of distance learning technologies to during quarantine arises for many: for children with special needs; to work with gifted children, in particular during the preparation for writing research papers and subject competitions; to independently raise awareness in a particular subject area; to close knowledge gaps, etc.



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Methodical, theoretical and practical aspects of the use of distance learning technologies are devoted to some scientific works of Olga V. Bondarenko [27], Liudmyla H. Havrilova [9], Anna V. Iatsyshyn [35], Tetiana H. Kramarenko [22], Hennadiy M. Kravtsov [12], István Lénárt [14], Nataliia V. Morze [18], Larysa M. Petrenko [21], Serhiy O. Semerikov [19], Svitlana V. Shokaliuk [25], Eugenia M. Smyrnova-Trybulska [26], Oleg M. Spirin [29], Yurii V. Tryus [28], Elena V. Vihrova [3], Vasyl V. Yahupov [31], Myroslav I. Zhaldak [33] and others.

In the “Regulations on distance learning” [7] distance learning technologies are defined as an individualized process of acquiring knowledge, skills, abilities and ways of human cognitive activity, which occurs mainly through mediated through telecommunications interaction of distant participants in the learning environment in a specialized environment, on the basis of modern psychological-pedagogical and information-communication technologies.

According to Eugenia M. Smyrnova-Trybulska [26], distance learning is an independent educational and cognitive activity, one of the forms of learning.

Distance learning is the interaction of teacher and students at a distance in which all the components inherent in the educational process (purpose, content, methods, organizational forms and teaching aids) based on the use of specific means of Internet technology [13].

Volodymyr M. Kukharenko believes that distance learning is the acquisition of education in such an organization of educational and cognitive activities, when along with full-time and part-time in the educational process uses the best traditional methodological achievements of the past and innovative tools and forms of learning based on computer and telecommunication technologies. He singles out the provision of feedback, determination of intermediate results of educational activities for further adjustment of the educational process, in order to achieve the planned results as one of the main problems in the implementation of distance learning [13].

Based on online lessons and feedback can solve problems that arise during the teaching and learning of pupils and students to exercise its control and adjust as necessary.

The possibility of constant consultation with the teacher is an integral part of the distance learning system. It is this element, is communication, the result of which is feedback and the results of adjusting the learning process, distinguishes a properly organized system of distance learning [10].

There are platforms used to organize distance learning for students: Moodle, Google Classroom [4], GIOS, Coursera, Khan Academy, Prometheus and others. In particular, the materials of the educational platforms “My Class”, “For a Lesson” and “All-Education” were used for primary and secondary school students.

Studies by individual authors ([1], [16], [17], [18], [24], [25], [28], [33]) are devoted to the creation of distance courses based on Moodle. These include several tools, the use of which provides both management of educational resources and management at educational and cognitive activities of students a distance; provides an opportunity for students to study and work together with each other and with the teacher. Most of the courses developed in this system are for students and very few for students. As teachers did not have access and methodological support for the development of Moodle-based materials, such courses were used for students in isolated cases.

Many platforms for distance learning with already developed materials are paid, in particular – the educational platform “Global Innovative Online School. Mathematics, 5-9 grades” (GIOS) [7], recommended by the Ministry of Education and Science of Ukraine. Daryna V. Vasilieva considers the above platform as an effective tool for implementing blended learning: that is, when part of the new material is studied by students at home using the GIOS platform, and in the classroom, together with the teacher, students perform tasks to understand and consolidate at home of new material, for the formation of skills for solving problems on the relevant topic, for the diagnosis of acquired knowledge and skills, etc. [30].

The materials posted on the GIOS, My Class, Na Urok, and Vseosvita platforms were used by most Ukrainian teachers to study mathematics and computer science, prepare for the state final certification, and external independent assessment. After registering the account of the user (account) of the teacher, each account of the student was attached to the account of the teacher. Accordingly, the teacher had

access to the material developed by the students, easily and quickly monitored and evaluated the completed tasks.

The Coursera [5] and Prometheus [23] platforms are more aimed at students and high school students. There are courses to prepare for an external independent evaluation.

The main part of the courses on Coursera lasts 6-10 weeks. Each homework or test must be completed within certain of time. Upon successful completion of the tests and the final exam, the student is issued a certificate.

Courses at Prometheus consist of video lectures, dynamic tasks, a forum that is available at any time.

In the Khan Academy Ukrainian provides video clips and courses in Ukrainian, links to which can be posted on your distance learning course or website to learn new material.

In the process of teaching mathematics in general secondary education, namely during the teaching of the basics of probability theory, where you want to use, repeat and consolidate knowledge of geometry, algebra and the principles of analysis, you can use the software Gran (Gran1, Gran 2D, Gran 3D) on the remote server by the link: *gran.npu.edu.ua* access password *gran* [32], [33], [34].

3. Results

The introduction of distance education at the end of the school year was unexpected, so it required rapid preparation. Each teacher had to choose a convenient learning platform (because a single platform was not recommended). However, students had to master the features of several platforms simultaneously, which greatly complicates the learning process. The consequence of distance learning was that its didactic support was insufficient in various fields of knowledge and led to the need to develop their own e-learning materials (recordings of screen demonstrations, presentations with relevant comments, video tutorials, tests, independent and control works with automatic testing, etc.). Lack of experience in this mode was compensated by teachers' self-educational activities (webinars, practical online classes, exchange of experience, etc.).

Establishing feedback between all participants in the learning process has been a priority for class teachers and group curators [6]. To do this, systems were used to provide real-time communication (chats) for all students. Such systems include software Viber, Telegram or other systems for instant messaging (messengers). Based on their use, participants learned the latest news, received invitations to online lessons (for example, through Zoom) and reminders about the need to complete tasks for self-study. Sometimes, using the same messengers, students sent completed tasks.

In the first computer science lessons, it is advisable to create an account in the Google system (for those who do not have one), because many cloud services used for distance learning are offered by Google [11]. Next, students should be introduced to the peculiarities of working with Google Drive, Google Forms, Google Meet and other.

Google Meet and Zoom have become the mainstay of online classes for students. Using the tools "Marker", "Screen Demonstration", it was possible to bring them closer to face-to-face classes, although each of the services had certain disadvantages: for Google Meet – a limit of 25 participants (sometimes more students per class) (in versions for schools) 100 people, and at the time of quarantine expanded to 250 people), and for Zoom – a time limit of up to 40 minutes.

Monitoring and determining the intermediate results of students' learning activities have become the main problems of distance learning, as not all students are self-disciplined, conscious and independent. You can solve this problem by joining the "My School" systems at the link: <https://www.not.org.ua/my-school/> (figure 1) or "Unified School" at the link: <https://eschool-ua.com/#/> (figure 2). The use of these automated systems makes it possible to simplify the organization of the educational process with the help of the latest technologies. These automated information and communication systems are designed for educational institutions, students and their parents, as well as for education authorities and are recommended by the Ministry of Education and Science of Ukraine. Teachers, administration, students and parents are registered in the system. The latter can receive up-to-date information about the success of their child and see its rating among students of the class and school (figure 2b).

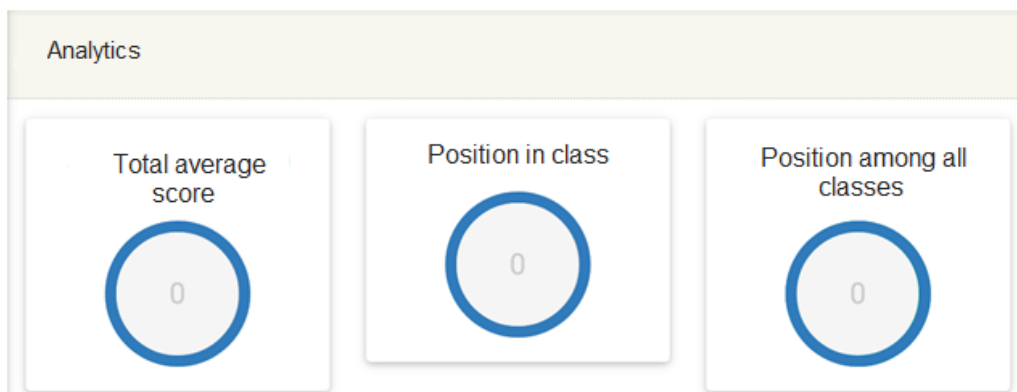


Figure 1. Information about the student's success in the system “My School”.

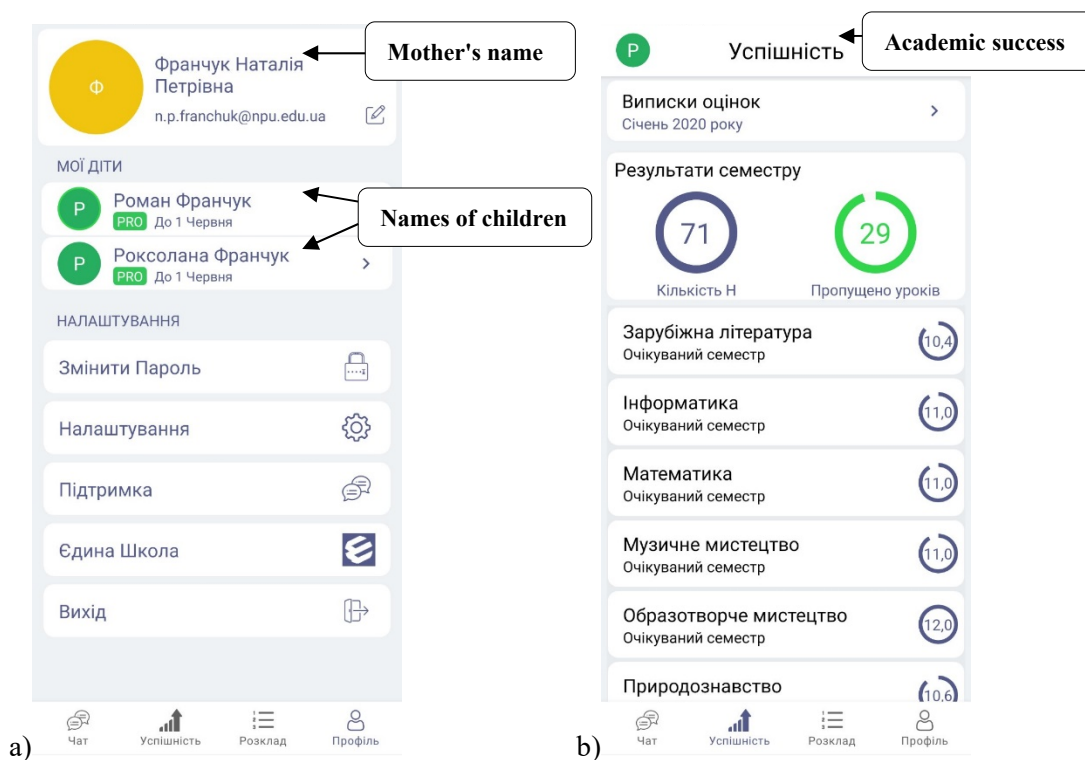


Figure 2. Information about the student's success in the system “Unified School”.

At the next stage it is necessary to develop a curriculum, which can include the following:

- theoretical material is submitted for self-study (paragraphs from the textbook, links to video lessons etc.), and the results of practical tasks are checked remotely;
- organization of online consultations of teachers: via video conferencing or telephone communication;
- providing students with distance lessons using Moodle for self-study (read theoretical material, answer questions, review examples of problem solving, perform test tasks to consolidate knowledge or creative task);
- online classes via Skype, Google Meet or Zoom (figure 3). The younger the age group of students, the more such classes need to be conducted;

- methodically motivated use of materials of platforms GIOS, “My class”, “On a lesson”, “All-education” considering individual features of pupils of a class;
- creation of virtual classes on “ClassDojo”, “Google Classroom” (figure 4), “Learning Apps” (the platform is available for use of laptops, personal computers, tablets, mobile devices);
- placement of forms of reference notes, schemes, algorithms, formulas that can be printed or filled out online;
- watching video lessons on real-time TV channels or on YouTube channels conducted as part of the School Online project. It is advisable to divide these video lessons into stages so that it is easier for students to get acquainted with them;
- to prepare students for external independent assessment to place tasks (in the form of Google Forms) on only one topic, pre-repeating the relevant material; offer to perform testing at the EdEra online education studio. The website www.osvita.ua contains the tasks of all external independent evaluation sessions with their automatic verification. If the task is done incorrectly, you can read the methodical comment on this topic and find out the correct solution. Topics in which mistakes were made should be further studied by notifying the teacher;
- use of communication tools in distance learning: e-mail (correspondence between teachers and students via the Internet for counseling and sending assignments); chat; teachers' personal web pages for posting materials (sites or blogs), Viber, Telegram or other messengers.

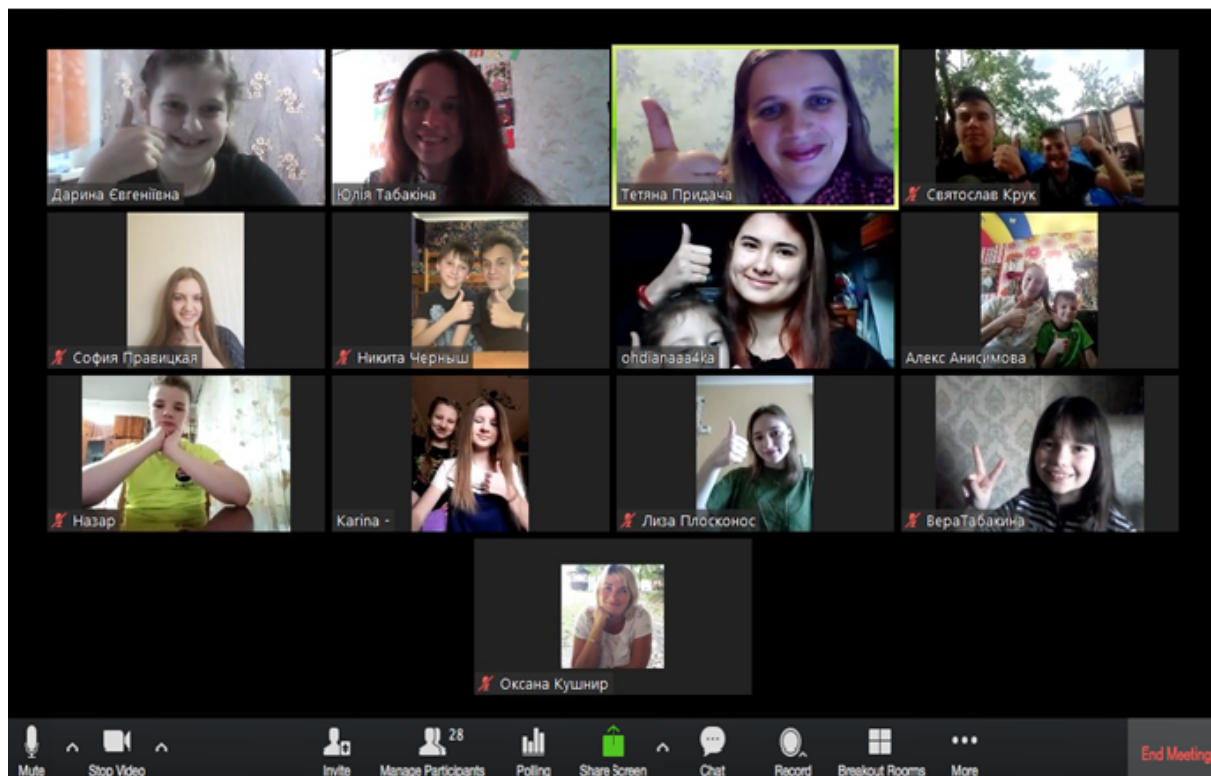


Figure 3. Screenshot of a consultation online math lessons.

One of the most effective forms of distance learning can be considered to conduct online classes via the Internet. According to the classification of types of lessons by Vasyl O. Onyshchuk [20], according to the didactic purpose and place of the lesson in the general system, the following are distinguished: the lesson of mastering new knowledge; a lesson of mastering skills and abilities; a lesson in the application of knowledge, skills and abilities; lesson of generalization and systematization; lesson of checking and adjusting knowledge, skills and abilities; combined lesson.

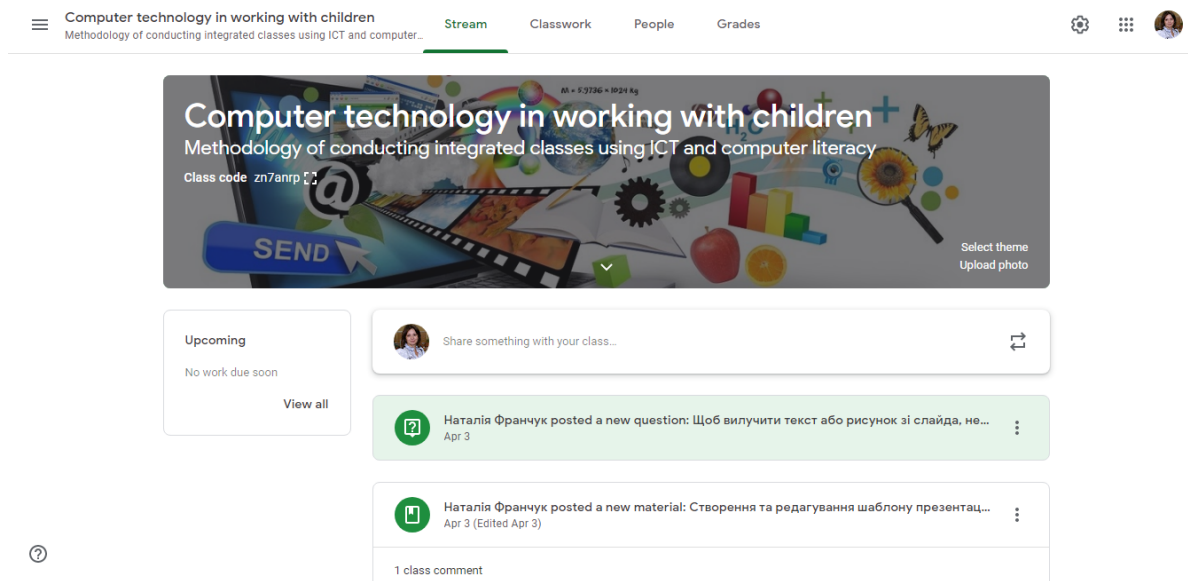


Figure 4. Creating virtual classes using the system “Google Classroom”.

Each type of lesson consists of certain elements that are mentioned below. Consider ways to present them during online math and computer science classes.

Organizational part. These include greetings, checking the means of communication, the availability of the necessary tools, announcing the lesson plan to increase attention, creating a working atmosphere, and so on. The time allotted for the implementation of this part of the lesson will depend on the quality of the preparatory work for the lesson: the availability of invitation links, the speed of data transmission over the Internet, the time to connect all participants to the meeting online. It is desirable to immediately show where the lesson record will be placed for re-viewing.

Homework check during distance learning can be done before starting the next lesson. At the same time, it is necessary not only to evaluate the work done, but also to comment on it, pointing out mistakes and inaccuracies, explain what caused them and how to correct them. For example, if it was a test, students receive a grade immediately after completing it with appropriate comments. During the online lesson, you can test your knowledge of formulas, definitions, etc. by interviewing several students. You can also give examples of tasks like homework, during which they caused the greatest difficulties. It is advisable to place these templates in the distance course or on the website so that students can get acquainted with them later, if they do not have time to write something down during the online lesson (figure 5).

Motivation and stimulation of educational activities is a very important stage of online lessons, because the effectiveness of the lesson in general depends on its effectiveness. It is better to interest students in studying a certain topic with the help of multimedia materials, demonstrations, dynamic models, etc. The teacher can comment on these materials, make notes, or ask the student to perform an experiment with a dynamic model and demonstrate its results using the demonstration mode of their screen. A significant number of resources of this type can be found on the Internet (YouTube videos, Khan Academy, educational portals “Na Urok”, “Vseosvita”). Links to these resources should be available to students after class.

When updating the basic knowledge, it is necessary to recall the previously studied material based on which new knowledge will be learned. This can be done by filling in mini-summaries, graphic diagrams, forms for which students transfer to a notebook or print out in advance. This will harmonize terminology and motivate students to deepen their knowledge on a topic. Such materials can be stored and used by students in the future to prepare for the state final certification and external independent

assessment, and students - for exams. In some textbooks, for example [2], you can find ready-made mini summaries (figure 6), located at the beginning of each paragraph.

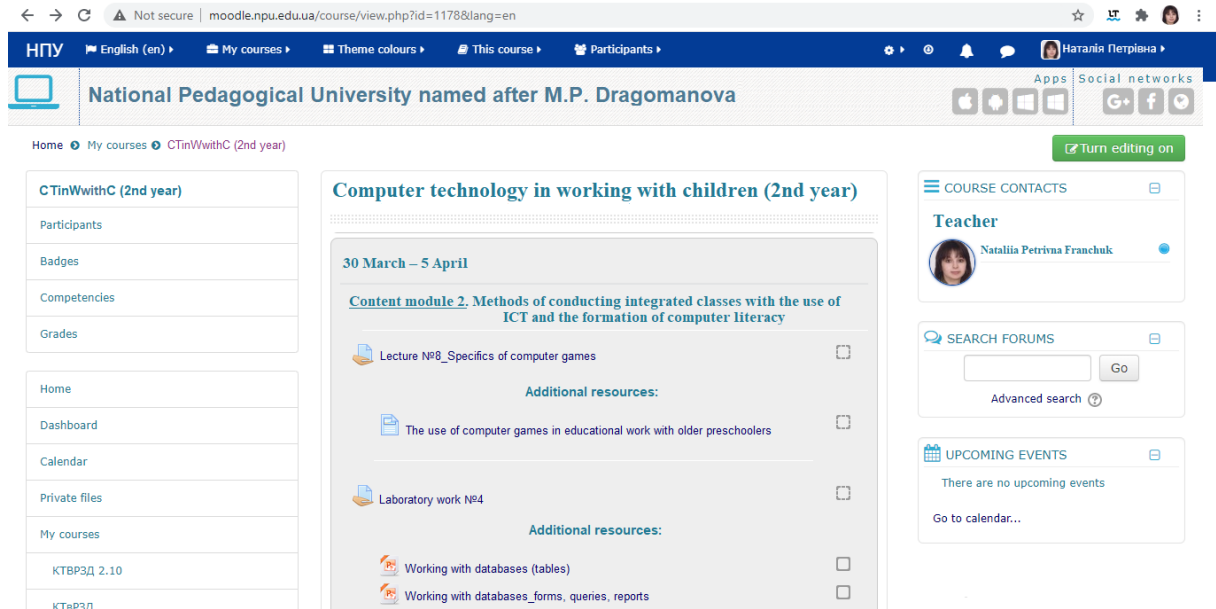


Figure 5. Placement of additional resources in the distance course.

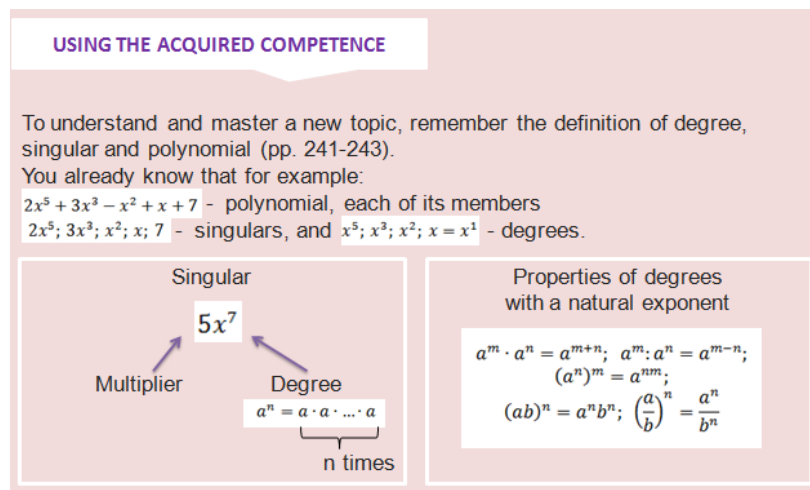


Figure 6. Mini-abstract for updating the basic knowledge on the topic “Division of degrees and singular” from the textbook [2].

The explanation of the new material is not only in its presentation, but also in the appropriate management of the process of assimilation of new knowledge by pupils. For successful mastering of new knowledge by pupils, the teacher must take care of:

- proper perception and understanding of educational material. It is advisable to present new facts in the form of presentations with animations. Only the basic concepts and statements that the participants should summarize while listening to the teacher's explanations should be presented on the slide. It is desirable that all presentations be created according to the same templates. Only the main thing should be distinguished by color and borders, then the participants will

know without comments what exactly should be written in a notebook. Also, at this stage, students should be offered algorithms and examples of solving typical problems, indicating the pages of the textbook on which they are placed;

- consolidation of new knowledge occurs by interviewing students, performing tasks under the guidance of the teacher (demonstration of screens), you can do a little independent work, etc.;
- the application of new knowledge in various situations can be carried out while working in online laboratories, showing the applied orientation of the material being studied. At this stage, you can perform tasks of increased complexity or tasks from the textbook under the heading “We use the acquired competencies”. Here you can use a group form of work to implement interdisciplinary projects, the topics of which can be found in textbooks or in the curriculum of the discipline. Specialists from different professions can be invited to participate in the online lesson to share experiences and further motivate them to study the subject.

Diagnosing students' knowledge helps teachers and students to determine the reason for not understanding a certain element of the content of learning, inability or erroneous performance of intellectual or practical action. It can be realized through the creative transfer of knowledge and skills to new situations; the student's work will be evaluated immediately if the tasks are automatically checked. It is better to make such tasks differentiated from several consecutive parts and to check not only the result, but also to control the process of obtaining it. When evaluating such work, it is necessary not only to set the obtained score, but also to comment on non-standard solutions and techniques, providing an individual approach to the creative findings of students. For example, for the beginner and intermediate levels, you need to choose the correct option from several suggested, for the enough one – enter the correct answer, for the high level – send a file with a full solution.

Generalization and systematization of knowledge is quite effectively controlled during discussions, which allows students to discuss with each other and with the teacher problematic issues. By checking, analyzing and evaluating the work and projects of classmates, the student analyzes his own work and can adjust his further educational activities to get the best possible results. Tests and independent work should be carried out either in several variants, or with a random selection of questions to prevent write-offs. Be sure to include not only test tasks, but also open-ended tasks sent as files. This will allow you to check the correctness of reasoning, justification of steps, the correctness of the construction of the drawing (photo of the work performed, dynamic model, drawing, video fragment, etc.).

Summarizing the lesson involves a brief analysis of what students have learned in class, what knowledge and skills they have mastered, what is the importance of this knowledge for the next stage of learning. At the end of the online lesson, it is important to find out whether the lesson was clear enough, whether the students are satisfied with their work and the knowledge gained. To do this, you can conduct a survey using the Google Forms service, sending the appropriate smileys (tags) in the general chat, directly interviewing students.

As a homework assignment, it may be suggested to repeat the lesson materials that will be posted on the course or on the website, view additional web resources (for example, lessons via television), perform differentiated tasks, take a test or participate in discussions (forum), dynamic exercises in Learning Apps, etc. It is advisable for students to include paragraphs from the textbook where the material on the relevant topic is placed, so that they can work not only on the computer. The content of the homework should be recorded in the electronic diary of the system “My School” (figure 7), where you can attach the necessary files for processing and specify the end date for its implementation. If there is no electronic diary, the grades are communicated through the class teacher to each student individually.

As the epidemiological situation is currently unstable, the continuation of distance learning is possible in the future. Therefore, for its successful implementation it is necessary to follow the following recommendations:

- register on the selected distance learning platform, create groups, including students;
- create e-learning materials: publications with hyperlinks to the glossary of terms, dynamic models, links to various resources, practical tasks, etc., which are posted on the Internet;

- develop forms for sending answers to tasks: tests, e-mail addresses (preferably for each class separately due to the large number of works), etc.;
- share documents for comment, additional questions, group work on the project;
- assessment should be conducted individually, the score should be posted in the electronic diary of the “My School” or “Single School” systems to provide feedback to parents.

Figure 7. Page of the e-journal by the teacher in the system “My School”.

4. Conclusions

The study identified the specifics of using cloud technology in online math and computer science classes. The use and harmonious combination of modern information and communication technologies create links between the content (topic of the lesson) and the ways of joint and individual activities of learners. Which in turn contributes to the deepening of knowledge, increase motivation to study and work independently on subjects; organization of fruitful individual, group, frontal work of pupils and students for the purpose of formation of subject and key knowledge, abilities and skills; implementation of automatic updating of methodical materials; improving the information culture of participants in the educational process.

It should be noted that the considered software should be introduced to increase the efficiency of general secondary education, the use of which will help facilitate the interaction between teachers, parents and students. This will help motivate students to attend classes and study subjects.

Didactic foundations of distance learning were formed based on various pedagogical innovations and require the use of advanced learning models (problem-solving approach, project method, research teaching methods, etc.). During their implementation, not only the principles of classical didactics should be implemented, but also the specific principles inherent in the implementation of distance learning.

Systematic, purposeful, pedagogically balanced, methodologically motivated and theoretically substantiated use of distance technologies in teaching mathematics and computer science strengthens the motivation of cognitive activity, forms a lasting interest in research, contributes to the effective formation of personal qualities of students. Therefore, the task of the teacher is to create conditions for the disclosure of individual abilities of students, directing their cognitive activities to achieve the goal during online classes.

In the process of further research, it is necessary to develop methodological systems for distance learning in mathematics and computer science based on the effective use of modern cloud technologies.

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