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**ON SOME PEDAGOGICAL PROBLEMS OF DISTANCE**  
**LEARNING IN MATHEMATICAL DISCIPLINES DURING**  
**PANDEMIC**

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### Abstract

In the article, the authors summarize the experience of distance teaching of mathematical disciplines at the Financial University under the Government of the Russian Federation at various stages of the educational process being lectures, seminars, tests, pass/fail exams and exams during the 2020 pandemic. The positive role of technical means used for the classical distance learning form, having been applied at the Financial University for many years, is noted: the use of graphic tablets, PowerPoint presentations with prepared theoretical material on slides and specific tasks illustrating this material, virtual whiteboards, etc. The main mistakes made by first-year students of the faculty, specializing in economic sociology at the faculty of Social sciences and mass communications of the Financial University under the Government of the Russian Federation, when passing a test in mathematics in December 2020 have been analyzed. The positive role of the extracurricular contact between the teacher and students through various platforms has been noted. Various forms of control over the independence of students' tasks fulfillment during the performance of control, test and examination papers both in the first and second years of study have been analyzed. It has been concluded that the oral part of the online exam, when the students are face to face with the teacher in front of the camera and do not have the opportunity to get help outside, benefit a more adequate knowledge level determination and the correct grade awarding.

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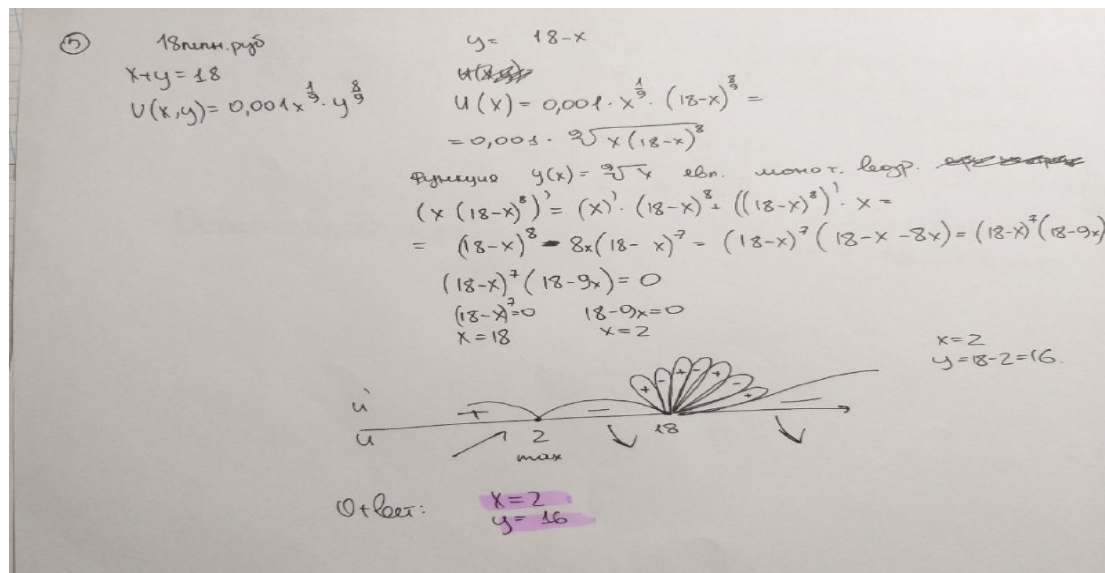
*Keywords:* Distance learning, graphics tablet, hyperlinks, pandemic 2020



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## 1. Introduction

In accordance with the Order of the Ministry of Science and Higher Education of the Russian Federation No. 1402 dated November 11, 2020, starting with November 16, 2020, all training at the Financial University was provided distantly (Orusova, 2020). According to this order, the test and examination sessions of the academic year 2020-2021 were also held remotely. The following distinctive features of adopting a distance learning form caused by a pandemic should be noted: 1) surprise; 2) internationality; 3) popularity; 4) prevalence; 5) binding (Abdulrahman et al., 2020). The entire education system had to respond to these challenges in a stressful mode (Anisimov & Vasiliev, 2020). At the same time, the Financial University and, the Department of Mathematics in particular, coped with the tasks at all stages of training largely using the experience of implementing extramural and online education (Orusova, 2020).



**Figure 1.** Solution of Task 1 as part of pass/fail examination in mathematics by the first year student in the first semester, estimated at 2 points out of 10 for choosing the correct solution algorithm, but not the correct solution

## 2. Problem Statement

The pandemic has exposed a problem in quality mathematics teaching at both school and university levels. The tasks set in the work are as follows: 1) to demonstrate the gaps in algebra and analysis teaching methods applied to schoolchildren in grades 10 and 11 of a general education school by specific examples of the test work in mathematics prepared by first-year students; 2) to analyze the work of students at distance seminars and their answers to the written and oral exams in mathematical disciplines in the first and second year of the Financial University, taking into account the peculiarities of distance learning and passing exams.

### **3. Research Questions**

The features of teaching mathematical disciplines at the Financial University during extramural, distance and intramural education with the use of distance learning forms are studied.

The features of conducting online lectures and online seminars on mathematical disciplines at the Financial University with the involvement of various technical means and Internet platforms during forced distance learning caused by the coronavirus pandemic in 2020 are investigated.

The typical mistakes students make when taking online tests and exams in mathematics are analysed.

### **4. Purpose of the Study**

The purpose of the study is to summarize the experience of distance teaching of mathematical disciplines at the Financial University under the Government of the Russian Federation at various stages of the educational process being lectures, seminars, tests, pass/fail exams and exams during the 2020 pandemic and to explore the distinctive features of adopting distance learning due to pandemic.

### **5. Research Methods**

Synthesis, analysis, systematization, literature review, comparison and observation.

### **6. Findings**

The educational process in higher education consists of various stages. At each of these stages, teachers faced a number of problems during the 2020 pandemic.

1. Lecture. In the scope of a single work program, there is a difference in curriculum between intramural and extramural (classical and online) forms of study. Before the pandemic, the lectures with the implementation of intramural education were always delivered in person. With extramural form, previously recorded video lectures were provided. This year, lectures for full-time students have been held in an online format, which differs from video lectures but generates similar pedagogical problems being as follows: how to attract and retain the attention of listeners; how to note gaps in students' knowledge with practically no feedback; what examples illustrating theoretical knowledge to select and in what sequence to present them; what tasks to analyze and how thoroughly; what is the best way to use the Internet platform offered by the university for training. The Financial University uses Microsoft Teams as such a platform. Both video lectures and online lectures must take into account the online format and meet high requirements (Hammond et al., 2020).

2. Seminars. For online seminars, the main pedagogical problem, along with the listed ones, in our opinion, is the students' motivation. We have to think about how to stimulate students in an online format to answer the questions posed by the teacher, how to encourage them to participate in solving problems, how to overcome their fear of asking questions when they do not understand certain points, how to make a lesson an interesting interaction, rather than a boring observation of the teacher's pen, which deduces one formula after another?

The authors have extensive experience in conducting online classes at the Financial University, not only in 2020, but also for many years providing part-time and distance teaching. Let us note a few points that at least partially compensate for the lack of offline classes.

- Technical means implying use of a graphics tablet, virtual whiteboard, online platforms;
- Preliminary preparation. It is necessary to thoroughly choose tasks corresponding to the topic of the workshop. In particular, a very convenient and useful method is a PowerPoint presentation, where the main theoretical provisions and formulas on the topic of the seminar, as well as the conditions of the problems, are inserted in advance. It is recommended to solve problems online in real time using a graphic tablet, and after saving the presentation, provide students with it.
- Active online contact with listeners. This is primarily achieved by joint problem solving. It is recommended to ask students questions, listen to answers, and also give short tasks with a request to post the answer to the chat (for a couple of minutes).
- Scoring policy. Since the final grade is added up as the sum of the points scored by the student in the semester and the points received in the mid-semester certification, the accrual of points for active participation in the learning process is an important incentive for students.
- Homework and its check. In accordance with the curriculum, students of any form of education perform control or calculation and analytical work. Unfortunately, under the conditions of the pandemic and online learning, all these tests have the format of homework and it's rather difficult to check whether students perform the tasks by themselves. In this regard, it seems necessary to assign homework assignments to students after each seminar, limiting the deadline for their submission to a few days. For intramural students, such homework assignments were given at the end of each seminar, the results were sent to the teacher by e-mail. The distance students were trained on the basis of the MOODLE platform, where such an opportunity is provided, time is limited and there is an opportunity for the student to attach a solution, and for the teacher to check it.
- Out-of-class contact across different platforms (MOODLE and Microsoft Teams). The lack of communication with the teacher due to the lack of face-to-face classes has to be compensated for in various ways. Each student has the right to get help from the teacher in clarifying unclear points by asking questions about theory or analyzing a solution. Therefore, tutorials play an important role and are held in various formats: group, individual in the form of questions by e-mail, the Microsoft Teams chat, the MOODLE forum.

Unfortunately, any, even the most modern methods of distance learning cannot replace a “live” teacher, real contact between the teacher and the student. This conclusion has been made based on analyzing the students’ mistakes on the exam and test.

3. Assessment implies conducting tests online and is of particular difficulty. The Financial University provides several models for students’ formative assessment. The Department of Mathematics for intramural students has adopted a model 1 implying an online test, which is implemented with examination papers for the discipline “Mathematics” and in a centralized form on the MOODLE basis for the discipline “Data Analysis”. This form was introduced as an experiment at one of the faculties. For the

classic extramural form of study in connection with the pandemic, model 2 is being implemented, replacing the oral exam, which consists of solving tasks (tests prepared on the appropriate platform) and an oral interview on exam papers. For online education, MOODLE is used with final tests posted on it.

Assessment implicates adherence to the following principles:

- Compliance with the installed model;
- Checking the material coverage, required competencies development;
- Adequacy of assessment in accordance with the complexity of tasks;
- Fairness in grading;
- Independent student fulfillment of examination tasks.

Obviously, the latter is the Achilles' heel when taking a test or exam online. The Department of Mathematics of the Financial University has developed many measures to prevent students from unauthorized performance of exam tasks like turning on video cameras, random choice of an examination paper or parameters in a task, etc., to the extent of disabling the copy keys with the help of a special program. However, we have to admit that a student is always more resourceful than a teacher in this regard. In this sense, the 2nd mixed, or hybrid model, which was used for students of extramural education, is much more productive.

If a student uses outside help when performing the test online, he has a face to face meeting with a teacher, who gives an adequate grade based on the oral answer. The mark consists of 60 % of the exam answer (the test is 30 % of the answer score) and 40 % of the progress during the semester, i.e. the contribution of the test to the final grade is 18 % of the total score, which enables to quite adequately assess a student's knowledge. The analysis of the exam results in the discipline "Data Analysis" in the winter session of the 2020–2021 academic year at the Institute of Distance Learning showed a positive correlation between the points scored by students for progress during the semester, where a great contribution was made by the degree of activity in the educational process, and the scores received for the oral component of the exam, while many students who did not manage to approve themselves succeeded in the test part of the exam. Thus, the conclusion is as follows: the oral part of the online exam, when a student is face to face with a teacher by means of camera and does not have the opportunity to use outside help, benefits a more adequate determination of the knowledge level and provision with the correct grade.

The so-called online education (Institute of Online Education of the Financial University) presents a special case. This year, dealing with such students was implemented in MOODLE (with the exception of seminars in Microsoft Teams). This platform enables to create a very convenient course, where both a student and a teacher are given great opportunities. The teacher can conveniently structure the course, creating personal pedagogical design from the work program to the final tests. The total grade is calculated for each student automatically in accordance with the scale entered by the teacher into the grading system. It seems very important to choose the correct rating scale (Keller et al., 2020). The Department of Mathematics has developed a point-rating scale that combines the rigor and flexibility of assessment.

MOODLE is a quite convenient platform for both students and teachers, and it can be used for students of any education form with regards to the prospects of hybrid education. However, MOODLE

can be used as an auxiliary tool with intramural form. In the intramural mode, MOODLE is being already used for training and conducting a unified exam (pass/fail exam) in the discipline “Data Analysis”.

Unfortunately, this academic year the system has been introduced hastily, without preliminary training of teachers. System adaptation and filling with content paralleled with the educational process. Therefore, it was impossible to avoid a number of difficulties and mistakes when developing a course design on MOODLE, for example, such as:

1. The contradiction between the requirements of the teacher’s independent filling of the module and the Department’s requirement for the uniformity of content and control materials.

2. Difficulties in the synchronous process of content creation, its technical implementation and the implementation of the educational process, etc.

In general, high-quality teaching and objective formative assessment provided online are very problematic and require a lot of time and effort from the teacher: pre-filling the course, preparing and checking homework after each lesson, conducting a large number of consultations, thorough analysis of the most frequently encountered errors and search for ways to eliminate them. Teachers feel the problems associated with a change in the teaching load, an increase in the amount of preliminary work as well as the threat of being excluded from the educational process (Lobova & Ponkina, 2021). In general, the role of the teacher is changing, the development of new electronic resources and technologies by the teacher, the role of a “navigator” comes to the fore (Tulchinsky, 2017). Overcoming these difficulties is of the highest priority for us. This also applies to the situation when intramural students were forced to adapt to online education due to the 2020 pandemic.

The first semester of teaching mathematics at the Financial University in various areas of student training according to the approved curriculum includes, among other things, teaching students the basics of mathematical analysis, in particular, functions of one and several variables. Many students did not cope with the tasks for the derivative application, possibly partly due to the forced distance learning in November-December 2020 caused by the coronavirus pandemic when passing the test in December 2020 in mathematics.

Let us analyze the typical mistakes made by students when completing such assignments.

**Task 1.** An entrepreneur decided to found a new farm for producing vegetables and has 18 million rubles for the development of this farm. It is known that if  $x$  million rubles are allocated for the lease of land, premises and the purchase of new equipment, and one million rubles for the salaries of employees, then the increase in the volume of output will be  $u(x, y) = 0,001x^{\frac{1}{9}}y^{\frac{8}{9}}$ . How should the funds be allocated to maximize the turnout increase?

**Solution.** Figure 1 shows the solution of a student who thoroughly did homework in mathematics during the semester, took an active part in seminars, coped with independent and control works and scored 39 points out of 40 for two certifications, which is a very good result. The student understood what function monotonicity was, she found the derivative only from the internal function of the investigated complex function (the external function is monotonically increasing). However, the sign of the derivative was incorrectly put in the extreme right interval (at plus infinity). Thus, we can conclude that the student did not master the main method for calculating the limits being the method of isolating the main part. The

presence of seven “clouds” with “plus” or “minus” signs in them testifies to the deep problems traced to school when teaching the solution of inequalities by the method of intervals (Borisova, 2020).

## 7. Conclusion

In conclusion, we note that the ability to think logically, which is provided by mathematical disciplines, is necessary in any field of activity. When solving any task, it is recommended to adhere to a simple algorithm: first we find the constraints, then we investigate the limiting cases, then we do all the other steps.

Thus, it is vital to find ways for optimal pedagogical solutions that benefit high-quality training of students in mathematical disciplines in any conditions and amid any challenges and difficulties faced by the society, even a pandemic. The future of education lies in a hybrid form, an optimal combination of online and offline learning, using all available technologies but with the preservation of the leading role of the teacher in the educational process.

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