PERIÓDICO TCHÊ QUÍMICA
CASE STUDY

EFICIÊNCIA DAS TECNOLOGIAS REMOTAS NA ABORDAGEM DO CONTEÚDO DE UM CURSO DE MATEMÁTICA E-LEARNING USANDO O SISTEMA MOODLE: ESTUDO DE CASO

EFFICIENCY OF REMOTE TECHNOLOGIES ON THE APPROACHING THE CONTENT OF A E-LEARNING MATHEMATICS COURSE USING MOODLE SYSTEM: CASE STUDY

ЭФФЕКТИВНОСТЬ ДИСТАНЦИОННЫХ ТЕХНОЛОГИЙ В РЕАЛИЗАЦИИ ЭЛЕКТРОННОГО ОБРАЗОВАТЕЛЬНОГО КУРСА ПО МАТЕМАТИКЕ, СОЗДАННОГО НА БАЗЕ LMS MOODLE: ТЕМАТИЧЕСКОЕ ИССЛЕДОВАНИЕ

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RESUMO

No sistema de ensino superior, o ensino a distância usando cursos eletrônicos de educação está se tornando a maneira mais relevante e amplamente exigida de aprendizado. Isso se deve principalmente ao rápido processo mundial de digitalização da educação. Além disso, em conexão com a transição para um sistema educacional de dois níveis, o número de horas no currículo dedicado ao trabalho independente dos alunos aumentou significativamente. Essas tecnologias são uma boa ferramenta para organizar a independência cognitiva de um aluno. As vantagens são a capacidade de estudar a qualquer momento, em qualquer lugar, a capacidade de aprender no próprio ritmo e a capacidade de aprender sem interromper o trabalho. Por outro lado, existem algumas deficiências, como o problema de identificação do usuário e a necessidade de o aluno ter uma forte motivação. Este estudo teve como objetivo mostrar uma das opções para organizar o trabalho independente dos alunos no exemplo do curso educacional eletrônico "Matemática e fundamentos do processamento de informações matemáticas", criado com base no sistema LMS MOODLE. Participaram do experimento 30 estudantes de dois grupos acadêmicos (15 pessoas cada), com idades entre 16 e 17 anos, estudando na Universidade Federal do Instituto Elabuga de Kazan (Volga). Um dos grupos dominou a disciplina "Matemática e Fundamentos do Processamento de Informações Matemáticas" na forma tradicional, o outro grupo - na forma remota, usando o curso educacional eletrônico desenvolvido pelos autores. Depois de estudar o curso em ambos os grupos, foram realizados trabalhos de verificação e uma pesquisa. O processamento dos resultados do trabalho de controle usando métodos estatísticos possibilitou avaliar quanto o sucesso dos alunos em matemática depende da escolha da forma de treinamento. Os resultados da pesquisa permitiram aos autores formular maneiras de melhorar a qualidade da matemática do ensino a distância usando um curso educacional eletrônico

Palavras-chave: *matemática, tecnologias de educação a distância, processamento de informações, avaliação de desempenho.*

ABSTRACT

In the higher education system, distance learning using electronic educational courses is becoming the most relevant and widely demanded way of learning. This is primarily due to the rapidly developing

worldwide process of digitalization of education. Besides, in connection with the transition to a two-level education system, the number of hours in the curriculum devoted to students' independent work has significantly increased. These technologies are a useful tool for organizing a student's cognitive independence. The advantages are the ability to study at any convenient time, anywhere, the ability to learn at one's own pace, and the ability to learn without interrupting work. On the other hand, there are some shortcomings, such as the problem of user identification and the need for the student to have strong motivation. This study aimed to show one of the options for organizing students' independent work on the example of the electronic educational course "Mathematics and Fundamentals of Mathematical Information Processing", created on the basis of the LMS MOODLE system. The experiment was attended by 30 students from two academic groups (15 people each) aged 16 to 17, studying at the Elabuga Institute of Kazan (Volga) Federal University. One of the groups mastered the discipline "Mathematics and Fundamentals of Mathematical Information Processing" in the traditional form, the other group - in the remote form using the electronic educational course developed by the authors. After studying the course in both groups, verification work and a survey were conducted. Processing the results of the control work using statistical methods made it possible to assess how much the success of students in mathematics depends on the choice of the form of training. The survey results allowed the authors to formulate ways to improve the quality of distance learning mathematics using an electronic educational course.

Keywords: *mathematics, distance educational technologies, information processing., performance evaluation.*

АННОТАЦИЯ

В системе высшего образования дистанционное обучение с помощью электронных образовательных курсов становится наиболее актуальным и широко востребованным способом обучения. Это связано, в первую очередь, со стремительно развивающимся во всем мире процессом цифровизации образования. Кроме того, в связи с переходом на двухуровневую систему образования значительно возросло количество часов в учебном плане, отводимых на самостоятельную работу студента. Эти технологии являются хорошим инструментом для организации познавательной самостоятельности студента. Преимущества - способность учиться в любое удобное время и в любом месте, способность учиться в своем собственном темпе и способность учиться, не прерывая работу. С другой стороны, есть некоторые недостатки, такие как проблема идентификации пользователя и потребность в сильной мотивации учащегося. Целью данного исследования было показать один из вариантов организации самостоятельной работы студентов на примере электронного учебного курса «Математика и основы математической обработки информации», созданного на основе системы LMS MOODLE. В эксперименте приняли участие 30 студентов из двух академических групп (по 15 человек в каждой) в возрасте от 16 до 17 лет, обучающихся в Елабужском институте Казанского (Приволжского) федерального университета. Одна из групп освоила дисциплину «Математика и основы математической обработки информации» в традиционной форме, другая группа - в дистанционной форме с использованием электронного учебного курса, разработанного авторами. После изучения курса в обеих группах были проведены проверочные работы и опрос. Обработка результатов контрольной работы с использованием статистических методов позволила оценить, насколько успехи учащихся по математике зависят от выбора формы обучения. Результаты опроса позволили авторам сформулировать способы повышения качества дистанционного обучения математике с помощью электронного учебного курса.

Ключевые слова: *математика, дистанционные образовательные технологии, обработка информации, оценка эффективности.*

1. INTRODUCTION:

In connection with the transition to a two-level education system, the number of hours in the curriculum devoted to students' independent work has significantly increased. For its active organization, distance educational technologies are widely used. Also, these technologies play an essential role in the rapidly developing worldwide digitalization of education (Schmidt & Tang, 2020).

Remote educational technologies are understood to be technologies that are implemented primarily with the use of information and telecommunication networks with the indirect interaction of students and teachers (Kuderova *et al*., 2019). There are various ways of organizing distance learning: using electronic educational resources (Anisimova & Krasnova, 2015; Akhmetshin *et al*., 2019), digital educational resources, massive open online courses (MOOC), offering extensive interactive participation and open access through the

Internet (Kaplan & Haenlein, 2016).

Due to the intensification of the digitalization of education worldwide, not only colleges and universities but also schools pay attention to various ways of distance learning (Dawson *et al*., 2009; Fuller, Vician, & Brown, 2006; Guri-Rosenblit, 2016; Kearsley, 2000). Online learning is gaining popularity every day, significantly expanding the educational space (Beese, 2014; Soekartawi, & Librero, 2002) and allowing students to independently study various educational programs (Aktaruzzaman & Plunkett, 2016).

In addition to the fact that distance educational technologies are an excellent tool for organizing a student's cognitive independence, there are many other advantages of their use.

Firstly, the opportunity to learn at a convenient time. Indeed, studying remotely, a student has the opportunity to build his or her own individual training schedule, determine when and how much time to spend studying a particular material (Nguyen, 2015).

Secondly, the ability to learn at one's own pace (Thoms & Eryilmaz, 2014). In the traditional form of training, the teacher, as a rule, focuses on a particular group of students – average performers. In the case of distance learning, the learning process takes place at a pace convenient for the student. He or she can always return to the study of more complex topics, re-examine the lecture material, ask questions to the teacher online.

Thirdly, the ability to learn in a convenient place (Bachmaier, 2011; So & Brush, 2008). With the remote form of training, a student can study without leaving home, which is especially important for people with disabilities, for people with small children.

Also, other significant advantages are the opportunity to learn without interrupting work; availability of training materials (with the remote form of training, all educational material, as a rule, is posted on the course);

Non less critical, it has to be considered the possibility of implementing an individual approach (Korableva *et al*., 2019 a, b). In the traditional form of teaching, it is quite difficult for a teacher to pay attention to each student to adapt to the pace of each of them. In the case of the remote form, students have the opportunity to receive answers to their questions in a mode convenient for them.

Besides, the convenience for the teacher. With distance learning, the teacher can pay attention to each student, has the opportunity to observe the learning process, even while on a business trip. Although, at the same time, the load on the teacher increases, so it is necessary to provide the teacher with appropriate financial support, reduce his or her workload (Meyer & Barefield, 2010).

However, there are several disadvantages of this form of training, which make teachers doubt the effectiveness of the use of distance technologies in the educational process. Indeed, in the modern educational environment, the success of the introduction of distance learning largely depends on the perception of teachers.

One of the shortcomings is the need for a student to have strong motivation. Since the student learns all the material on a distance-learning basis, this requires good willpower, self-discipline, perseverance, and responsibility (Chow & Croxton, 2017).

Another topic is the bias toward theoretical knowledge. Indeed, with the remote form of training, it is rather difficult to carry out the study of disciplines that require a large number of practical classes. This is especially true for the disciplines of the natural science cycle.

The problem of monitoring the learning process is also relevant. Unfortunately, in most cases with distance learning, it is impossible to check how honestly the student is concerned with completing assignments and whether he or she performs them him/herself. Therefore, the final form of control should be carried out in the audience.

The impossibility of developing such personal qualities as sociability, teamwork, oratorical qualities (Joksimović *et al*., 2015; Keller *et al*., 2017; Liaw, Huang, & Chen, 2007; Xiao, 2018) might put this tool in dought. At the same time, for people experiencing difficulties with socialization in the real world, distance learning is a definite plus, allowing one to get an education in a comfortable environment (Sazmandasfaranjan *et al*., 2013)

Insufficient technical equipment of the teacher's and (or) student's workplace (Anderson & Dron, 2011; Hung, 2016; Rogerson-Revell, 2015) can also be faced as a disadvantage.

It is also important to remember the students' poor computer literacy (Hatlevik *et al*.,

2018; Hoffman & Vance, 2005) and insufficient degree of mastering the material compared to traditional training (Kirtman, 2009). For example, the number of students taking at least one online course increased in the USA in 2013 to 6.7 million people (Allen & Seaman, 2013). At the same time, the Pew Research Center found that, although many college leaders in America said their institutions offered online courses, only 50% agreed that these courses were at the same level as traditional study classes (Parker *et al*., 2011).

There are also institutional and financial problems that hinder the spread of distance technologies in the educational environment. The lack of qualified teachers (Baran *et al*., 2011), weak government support (Piña, 2010), unequal competitive conditions (Drori, 2015; Zawacki-Richter & Anderson, 2014). Even in an academic environment, such a concept as "brand" is crucial. Therefore, large universities will have a more significant competitive advantage, positioning themselves as experts in creating educational materials of the required quality. They will also be more competitive because of the economic benefits of the number of students enrolling in their courses, as large universities have more opportunities to expand the audience of their courses through, for example, opening branches and representative offices in the regions. However, in turn, this forces regional universities to focus on more innovative teaching principles.

Thus, distance learning is a rapidly developing field in the field of education, including higher education (Reese, 2015). Distance education is developing per the goals set to increase the power, speed, and accessibility of educational technologies (Conde *et al*., 2014; Shannon & Rice, 2017).

However, despite the advantages of distance learning, there are obstacles of a personal, institutional, and financial nature for the holistic implementation of the distance learning system in the educational process (Leontyeva, 2018).

Therefore, this study aimed to show one of the options for organizing students' cognitive activity that allows students to organize their independent work as efficiently as possible (by the example of the distance course "Mathematics and Fundamentals of Mathematical Information Processing," created based on the LMS MOODLE system), to evaluate the effectiveness of the use of distance learning technologies in the study of mathematics and formulate possible ways to improve the quality of distance learning mathematics using an electronic educational course (based on statistical data collected in the process of students' work on the indicated course).

2. MATERIALS AND METHODS:

First, the authors briefly describe the structure of the course "Mathematics and Fundamentals of Mathematical Information Processing," created based on the LMS MOODLE system at the Elabuga Institute (branch) of the Kazan (Volga) Federal University (KFU) and posted on the KFU website for distance education (edu.kpfu.ru), disclose the algorithm for working with it, and then reveal the essence of the pedagogical experiment conducted by the author of the article to evaluate the effectiveness of the use of distance learning technologies in the study of higher mathematics at a university.

This educational distance learning course consists of the following topics (sections):

1. The primary means of presenting information in mathematics and their use in the pedagogical activity.

2. Elements of set theory. Counts. Functions.

3. Elements of probability theory.

4. Aspects of mathematical statistics.

Each section has the following structure (see Table 1):

Table 1. *Section Structure*

№	Components
1.	Methodical recommendations to the student on the study of the topic.
2	Lecture material.
3	Questions for self-control.
4.	Test.
5.	Verification work.
6.	List of references.
7.	Glossary.
8.	Forum.

The content of the course is entirely consistent with the work program of the discipline.

The study of each section should begin by reading the guidelines (see Table 2), which

allow the student to build an algorithm for his work on the topic.

Each section includes lecture notes and self-examination questions (see Table 3). After studying the lecture material, the student proceeds to questions. Questions for self-control allow the student to evaluate the success of mastering the studied material independently. If difficulties arise with the answers to them, the student can return to studying the part of the lecture material that caused the challenges. Next, the student proceeds to test (see Table 4), the results of which demonstrate the degree to which the student has mastered this material and the possibility of moving to the study of a new section. Each test contains from 5 to 10 questions. The correct answer to one question is estimated at one point. To proceed to the next step (performing verification work), it is necessary that the student have at least 50% of the correct answers. As noted above, one of the features of LMS MOODLE is the ability to customize the course so that students get access to subsequent classes only after completing previous tasks. Therefore, it is possible to open for students' access to following forms of control only after completing the previous form for a satisfactory assessment. Testing can also be repeated if the initial result does not meet the requirements established by the teacher (these attempts are visible to the teacher from his/her personal account). The final form of control for each section (except section 1, which is primarily theoretical, and involves only the execution of the test) is the verification work (typical tasks for each topic can be seen in table. 5). The completed verification work is sent to the teacher for evaluation. Based on these forms of control, an assessment is made.

After studying all the sections, it is necessary to pass the final test, the questions (tasks) of which cover all the lecture and practical material on the course. The ultimate test consists of 30 questions (see Table 4). It includes questions from all the tests that are in sections 1-4.

Each section also includes a list of references, which can be useful in the case of questions in the process of studying the material. The student can also ask a question directly to the teacher on the course using interactive forms of communication integrated into the LMS MOODLE system (forum, chat), and the student can find the basic definitions and terms encountered in the process of studying the discipline in the glossary.

As noted above, one of the drawbacks of distance learning is the fact that it is impossible to evaluate how honestly one or another student completes assignments fully, it is impossible to verify whether he or she independently completed the proposed appointments. Therefore, the course ends with a final verification work, which is conducted in the audience and includes tasks from each topic of the course (see Table 5).

The study involved 30 students aged 16 to 17 years of first year at the Faculty of History and Philology of the Elabuga Institute of Kazan (Volga Region) Federal University. Among them were 26.67 percent of boys (8) and 73.33 percent of girls (22).

The experiment was conducted from September 2018 to December 2018.

At the beginning of the 1st semester (the 2018-2019 academic year), two groups of students were selected studying in the direction of 44.03.05 – Pedagogical Education (with two training profiles). The profile of the preparation of group No. 1 is the Russian Language and Literature, that of group No. 2 is History and Social Studies. The first group mastered the discipline "Mathematics and Fundamentals of Mathematical Information Processing" in remote form using the electronic educational course described above, the second - in the traditional style.

Since distance learning is currently very relevant, it is fully implemented at the Yelabuga Institute. Each university teacher develops electronic training courses that are widely used in teaching. Students subscribe to these courses without fail and undergo training under strict supervision.

The written permissions of the subjects to use their personal data allowed us to process their exam results, verification work, and survey.

In each group, 15 students were selected (in the first group there were 12 girls, 3 boys, in the second - 10 girls, 5 boys) with the following scores for the exam in mathematics (basic level):

Group No. 1 – 11, 12, 14, 12, 15, 16, 15, 16, 14, 16, 17, 16, 13, 14, 12.

Group No. 2 – 12, 11, 16, 14, 16, 14, 16, 14, 11, 15, 16, 17, 12, 13, 15.

Students were selected in such a way that their math exam results were not significantly different from each other.

First, it is necessary to find out whether it is advisable to experiment with these students. To do this, it is necessary to find the coefficient of variation. In this case, quantitative data (exam results) will be interpreted using one of the methods of statistical information processing - correlation analysis. First, it is necessary to calculate the sample average (1):

$$\bar{x} = \frac{\sum_i x_i}{\sum_i n_i} = \frac{11+...+15}{30} = 14.17 \quad (1)$$

Next, it is needed to find the error of representativeness of the sample average (2):

$$S_x = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{n(n-1)}} \approx 0.3427 \quad . (2)$$

Finally, need to find the coefficient of variation (3):

$$C_x = \frac{S_x}{\bar{x}} \cdot 100\% = \frac{0.3427}{14.17} \cdot 100\% \approx 2.42\ \%. \quad (3)$$

These calculations were performed in MS Excel.

Since in this case, the coefficient of variation is less than 3%, therefore, the participants in the groups do not significantly differ from each other in the number of USE scores in mathematics, and research can be carried out.

As mentioned above, in group No. 1, classes were conducted in a remote format using the course described above, and group No. 2 studied in the audience. At the end of the semester after completing the course, verification work was carried out (in the audience) in both groups (see Table 5). The results of the verification work (in percent) of students selected for research are as follows:

Group No. 1: 62, 70, 80, 78, 74, 65, 75, 76, 60, 76, 60, 74, 64, 58, 78.

Group No. 2: 75, 80, 85, 82, 79, 72, 85, 88, 74, 70, 74, 88, 70, 78, 94.

It is necessary to evaluate how different the effectiveness of the test work is (and, consequently, the result of mastering the discipline as a whole) depending on the form of training. For this, it is necessary to find the coefficient of determination. At the same time, quantitative data (results of verification work) will be interpreted using one of the methods of statistical information processing - correlation analysis.

First, find the average value and variance in each group.

Group No. 1 (4)-(5):

$$\bar{x}_1 = \frac{\sum_i x_i}{\sum_i n_i} = \frac{62+...+78}{15} = 70. \quad (4)$$

$$D_1 = \frac{\sum_i (x_i - \bar{x}_1)^2}{\sum_i n_i} = 55{,}067. \quad (5)$$

Group No. 2 (6)-(7):

$$\bar{x}_2 = \frac{\sum_i x_i}{\sum_i n_i} = \frac{75+...+94}{15} = 79.6. \quad (6)$$

$$D_2 = \frac{\sum_i (x_i - \bar{x}_2)^2}{\sum_i n_i} = 141{,}6. \quad (7)$$

It is necessary to find the average value for all students (8):

$$\bar{x} = \frac{\sum_i \bar{x}_i \cdot N_i}{\sum_i N_i} = \frac{70 \cdot 15 + 79{,}6 \cdot 15}{30} = 74{,}8. \quad (8)$$

It is needed to compute the intragroup dispersion (9):

$$D_{intragroup} = \frac{\sum_i D_i \cdot N_i}{\sum_i N_i} \approx 98{,}333. \quad (9)$$

Then, it is necessary to find the intergroup variance (10):

$$D_{intergroup} = \frac{\sum_i (\bar{x}_i - \bar{x})^2 N_i}{\sum_i N_i} = 23{,}04. \quad (10)$$

Using the two previous values, need to find the total variance (11):

$$D_{total} = 98{,}333 + 23{,}04 = 121{,}373. \quad (11)$$

Finally, it is necessary to calculate the coefficient of determination, which characterizes how strongly the success of mastering the

material and the result of learning the discipline as a whole depends on the choice of the form of training (12):

$$\eta^2 = \frac{D_{intergroup}}{D_{total}} \approx 0{,}1898. \quad (12)$$

These calculations were carried out in MS Excel.

To improve the quality of distance learning mathematics using the electronic educational course in group No. 1, in addition to the test work, a survey was conducted (see Table 6). Data was collected and then placed in a database to organize information. Quantitative data were interpreted using descriptive analysis.

Table 6. *Questionnaire Content*

№	Question
1.	Did you enjoy studying math with the e-learning course?
2	Do you think that distance learning is as effective as traditional?
3.	What are the main advantages and disadvantages of distance learning.

3. RESULTS AND DISCUSSION:

The described experiment was conducted in order to assess the effectiveness of the use of an electronic educational course in the study of the discipline "Mathematics and the foundations of mathematical processing of information." For this, 30 students from two groups (15 people each) were selected. The first group during the semester studied mathematics in remote form using the electronic educational course described above, the second in the traditional form.

The processing of experimental results can be divided into three stages.

Initially, it was necessary to assess how appropriate it was to conduct an experiment among selected students. For this, based on the results of the exam in mathematics, the coefficient of variation was calculated $C_x \approx 2{,}42\ \%$.

The coefficient of variation allows to determine whether the subjects differ significantly from each other according to one or another sign.

It is generally accepted that differences between subjects in some way are insignificant if the coefficient of variation does not exceed 5%. To increase the reliability level of an experiment, this bar is sometimes reduced to 3%. Since in this case, the coefficient of variation is less than 3%, therefore, the participants in the groups do not significantly differ from each other in the number of USE scores in mathematics, and research can be carried out.

In the second stage, it was necessary to evaluate how strongly the success of mastering the discipline "Mathematics and the foundations of mathematical processing of information" depends on the choice of the form of training. To do this, at the end of the semester after studying all sections, verification work was carried out in both groups (see table. 1). Using the correlation analysis based on the results of the verification work, the coefficient of determination was calculated $\eta^2 \approx 0{,}1898$. Translating this value into percent, we have: $0{,}1898 \cdot 100\% \approx 19\%$.

The coefficient of determination allows o determine how strongly the results of the subjects are due to their belonging to a particular group.

The obtained result indicates that the success of mastering mathematics by 19% depends on the choice of the form of training. In order to determine which particular form of training is more effective, we compare the average values of the results of the test work of each group: $\bar{x}_1 = 70$, $\bar{x}_2 = 79{,}6$. Since, therefore, it is traditional learning that is 19% more effective than distance learning.

At the third stage, in order to improve the quality of distance learning mathematics using an electronic educational course, a survey was conducted in group No. 1 (see Table 2).

When answering the first question, 80% (12 people) of the respondents answered in the affirmative.

When answering the second question, approximately 73% of respondents (11 people) answered in the affirmative.

In answering the third question, students identified both the advantages and disadvantages of distance learning. They noted that the advantages of distance learning are that it is possible to study material and perform tasks

anywhere, in any free time, from any electronic device with Internet access. Students also noted a wide variety of teaching and assessment materials. Besides, students indicated that the electronic course is equipped with a lot of background information.

The main disadvantages of distance learning, according to the respondents, are the lack of full communication with teachers and fellow students (80% - 12 respondents), the lack of skills necessary for working with an electronic educational course (60% - 9 respondents), the difficulty of independent study of some topics (≈ 53.3% - 8 respondents), lack of video materials (20% - 3 respondents), negative attitude of parents to distance learning (≈13.3% - 2 respondents).

Thus, the results of the survey allowed us to formulate ways to increase the effectiveness of the developed electronic course in the study of mathematics. It is necessary:

- to conduct part of the lessons in the format of a video conference (LMS Moodle does not have a video chat function, however, Moodle can be combined with other software products);

- develop a training manual with a detailed description of the functionality of LMS Moodle or conduct an introductory training session to build skills with the electronic course;

- supplement the most complex topics with video lectures;

- attend orientation lectures with students and their parents to popularize distance learning.

Further research by the authors will focus on improving the quality of distance learning mathematics using an electronic educational course and assessing the effectiveness of distance learning in the study of other academic disciplines involving more students in the experiment.

4. CONCLUSIONS:

The students better assimilated the material in the traditional form of training. However, in cases where a student's presence in the audience is impossible for any reason (illness, family circumstances, etc.), distance courses, make it possible to remotely organize independent work of students and contribute to the development of self-education.

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Table 2. *Methodical recommendations to the student on the study of the topic*

№	Step
1.	Learn the lecture material.
2.	Answer questions for self-control. If the questions are complicated, you need to study the lecture material again.
3.	Study the primary literature, familiarize yourself with additional literature, new publications in periodicals, and familiarize yourself with the glossary.
4.	Run a test. Proceeding to the next step requires that there are at least 50% correct answers. If you have less than 50% of the right answers, you need to study the lecture material again and rerun the test.
5.	Perform test work. Make a report as a file and send it to the teacher for verification.
6.	If necessary, you can ask the teacher a question in the forum that arose while studying the topic or offer a topic for discussion.

Table 3. *Questions for self-control*

Topics (sections)	**Questions**
The main means of presenting information in mathematics and their use in pedagogical activity.	1. What is information? 2. What is the axiomatic method? 3. What is mathematical modeling? 4. What means of presenting information models do you know? 5. What types and methods of giving information do you know?
Elements of set theory. Counts. Functions.	1. What is a graph? 2. What methods of defining graphs do you know? 3. What is it «mathematical set»? What set is called empty, finite, infinite? 4. What are the basic operations on sets? 5. What is a function?
Elements of probability theory.	1. What events are called reliable, impossible, random? 2. What is the probability of a random event? 3. What are the conditions for the applicability of the theorems of addition and multiplication of probabilities? 4. What are the conditions for the applicability of the total probability formula, the Bayes formula. 5. What numerical characteristics of random variables do you know?
Elements of mathematical statistics.	1. What is the subject of mathematical statistics? 2. What is called the population, sample, variation series, statistical series? 3. List measures of central tendency, measures of variability. 4. What are the dispersion characteristics of the variational series. 5. What criteria for testing statistical hypotheses do you know?

Table 4. *Test tasks*

Topics (sections)	**Questions**
The main means of presenting information in mathematics and their use in pedagogical activity.	1. Experimental studies give: a) criteria for assessing the validity and acceptability in the practice of any theories and theoretical assumptions; b) the approach of the provisions on the study of the assessment of the acceptability of certain conclusions; c) means for obtaining knowledge about the object of study; 2. How many stages is the process of mathematical modeling divided into? Write down the answer in numerical format. 3. Is the statement true: “The first stage of mathematical modeling is the formulation of laws linking the main objects of the model”? a) yes; b) no. 4. What is a translation of text from German into Russian? a) information search; b) data structuring; c) changing the presentation of information; d) obtaining new information. 5. The second stage of mathematical modeling is: a) the formulation of laws linking the main objects of the model; b) the study of mathematical problems that lead to a mathematical model; c) ascertaining whether the accepted hypothetical model meets the criteria of practice.
Elements of set theory. Counts. Functions.	1. Set the correspondence between the name of the set and its designation: 1) set of natural numbers; a) N; 2) the set of integers; b) Q; 3) set of rational numbers. c) Z. 2. Were given the following sets: A = {2; 4; 6}, B = {4; 6; 8; 10}. Find A \ B. Choose one answer: a) {2}; b) {4;6}; c) {4;6;8;10}. 3. Set the correspondence between the designation of the operation and its name. 1) AΔB; a) difference / remainder; 2) AUB; b) crossing; 3) A\B; c) combination; 4) A∩B; d) symmetric difference. 4. If A is the set of even natural numbers, and B= {11, 22, 33, 44, 55, 66, 77}, then the number of elements of the set A ∩ B is equal (write down the answer in numerical format): ... 5. If A is a set of natural numbers less than 10, and B = {8,9,10,11,22}, then the number of elements of the set A \ B is equal (write down the answer in numerical format): ...

	6. Many points that can be connected by lines are called ....
	7. A closed route is called ....
	8. What is called the Euler path in the graph?
	a) a path containing all edges of the graph;
	b) a path that can be drawn on a plane so that no two of its edges have other common points except a common vertex;
	c) only edges of the directed graph;
	d) a path containing all edges of the graph whose degrees of adjacent vertices are 1.
	9. The function f (x) = x + sin2x is given. Find f (0).
	a) 0; b) 2; c) 1; d) -1.
	10. Find the domain of the function y=ln(1-x2).
	a) (0;1]; b) (-1;1); c) (-∞;-1)U(1;+∞); d) [-1;1].
Elements of probability theory.	1. In the task “Two shots are fired at a target. Find the probability that the target will be hit once. The test is:
	a) the target will be hit twice; b) two shots are fired at the target; c) the target will be hit once.
	2. A dice is thrown. Let us designate the events: A - “loss of 6 points”, B - “loss of 4 points”, D - “loss of 2 points”, C - “loss of an even number of points”. Then event C is equal to:
	a) C=A+D; b) C=A+B+D; c) C=A·B·D; d) C=A+B.
	3. Match:
	1) Event - “the letter M is selected
	from the word MIR "is; a) reliable;
	2) Event - “from an urn containing
	only white balls retrieve
	white ball "is; b) impossible;
	3) Event - “the letter K is selected from
	the word CHALLENGE is. c) random.
	4. If the complete system consists of 2 incompatible events, then such events are called ...
	5. Two students pass the exam. Events: A - “the first student will pass the exam”, B - “the second student will pass the exam” are:
	a) joint; b) independent; c) incompatible.
	6. Test - "throw two coins." Event - “at least one of the coins will have a coat of arms”. The number of elementary outcomes conducive to this event is (write down the answer in numerical format): ...
	7. The probability for a student to pass the first exam is 0.6, the second 0.4. The probability of passing at least one exam is:
	a) 0,24; b) 0,52; c) 0,76; d) 1.

	8. There are 10 textbooks on the shelf in random order. Of these, 1 in mathematics, 2 in chemistry, 3 in biology and 4 in geography. The student randomly took 1 textbook. What is the likelihood that he will be either in mathematics or in chemistry? a) 0,1; b) 0,2; c) 0,3; d) 0,24. 9. There are 2 white, 3 black balls in the urn. Two balls are taken out of the urn in a row. The probability that both balls are white is equal (write down the answer in numerical format): ... 10. Projects from three competing firms come for examination. The probability that the project of the first company will pass the examination with a positive assessment is 0.8, the second - 0.6, the third - 0.9. For examination, only one project was chosen at random. He passed it with a good mark. What is the likelihood that this was a project of the first company? Write down the answer in numerical format.
Elements of mathematical statistics.	1. Which statement about the general and sample populations is true? a) the sample and the population are equal in number; b) the sample - part of the general; c) the population is part of the sample. 2. The sum of the frequencies of the sign is equal to: a) 0; b) 1; c) sample size n. 3. A polyline, the segments of which connect the points with the coordinates (x_i, n_i), where x_i is the value of the variational series, n_i - is the frequency, is called .... 4. The statistical hypothesis is called: a) an assumption regarding the size of the population; b) an assumption regarding the size of the sample; c) an assumption regarding the parameters or type of distribution law of the population. 5. Is the true statement “The sample mean is the interval estimate of the mathematical expectation M (X), and the sample variance is the point estimate of the variance D (X)”? a) yes; b) no.

Table 5. *Verification task for students*

Topics (sections)	Task
Elements of set theory. Counts. Functions.	1. Two hundred forty applicants passed the Russian language exam, of which 170 people got a score lower than 5 points, 205 people passed this exam, i.e. got grades 3, 4 or 5. How many people got grades 3 and 4?
	2. Out of 37 students of the Faculty of Philology, 15 students received an excellent rating in Russian, 14 in literature, 18 in linguistics, 6 in Russian and literature, 9 in Russian and linguistics, in all three disciplines – 4. How many students received at least one mark of "5"?
	3. Badminton competitions are attended by ten athletes. Competitions are held according to the Olympic system, in which a participant is eliminated from the tournament after the first loss. What is the minimum number of hours that competition can be held if the organizing committee has 2 courts at its disposal and an hour is allocated for each meeting, including warm-up and relaxation?
Elements of probability theory.	4. For the exam, it was necessary to prepare answers to 30 examination papers. The student prepared only 25 of them. He takes out two examination papers in turn. Find the likelihood that he will pass the exam if it is necessary to answer at least one examination paper for this, and the first examination paper taken by the student contained unlearned questions?
	5. The same verification work was carried out in two groups. In the first group of 25 students, 8 received the "excellent" mark for their works, in the second, consisting of 30 students, there were 6 "excellent" works. What is the likelihood that the chosen random work from the randomly selected group will be "excellent"?
Elements of mathematical statistics.	6. Let a set of attribute values be given: 15; 20; 18; 20; 25; 11; 12; 13; 24; 23; 23; 24; 21; 22; 21; 23; 23; 22; 21; 14; 14; 22; 15; 16; 20; 20; 16; 16; 20; 17; 17; 17. It is necessary to compile a variational and statistical series of the distribution, to calculate the numerical characteristics.
	7. Five students were selected for participation in the programming Olympiad. A computer program records the time for solving each task (three tasks in total): the time to solve he first task (min): 24,16, 12, 5, 6; the time to solve the second task (min): 18, 14, 10, 4, 16; the time to solve the third task (min): 22, 15, 16, 12, 8. It is necessary to determine whether there are statistically significant differences between the time of solving the tasks?
	8. Fifteen first-year students were selected. They were asked the question "How much time did you spend preparing for the standings?" Their answers (in hours): 8, 6, 3, 1, 0, 5, 9, 2, 1, 4, 6, 10, 0, 3, 6. It is necessary to find the coefficient of variation and draw an appropriate conclusion.