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EVALUATION OF STUDENTS' ACADEMIC ACHIEVEMENTS IN MATHEMATICS IN THE CONDITIONS OF DISTANCE LEARNING DURING THE WAR: PROBLEMS AND RECOMMENDATIONS

Анотація. *Стаття присвячена аналізу та вирішенню проблеми оцінювання навчальних досягнень студентів з математичних дисциплін в умовах дистанційного навчання під час війни. Порівняно показники абсолютної успішності, якості успішності та середнього балу студентів Національного авіаційного університету при вивченні математичних дисциплін протягом останніх років в умовах очного та дистанційного навчання під час епідемії коронавірусу і російсько-української війни. Виявлено чинники, що впливають на об'єктивне оцінювання знань студентів в умовах дистанційного навчання під час війни, надано рекомендації щодо поліпшення адекватності оцінювання та запропоновано приклади тестових завдань, використання яких дозволить досягнути цієї мети.*

Ключові слова: *освіта в умовах війни, дистанційна освіта, оцінювання навчальних досягнень студентів, математичні дисципліни.*

Abstract. *The article is devoted to the analysis and solution of the problem of evaluating the academic achievements of students in mathematical subjects in the conditions of distance learning during the war. The authors compare the indices of absolute progress, the quality of grades and average marks of the students of the National Aviation University while studying mathematical subjects during the recent years in the conditions of full-time and distant education during the epidemic of coronavirus and the Russian-Ukrainian war. The factors influencing the objective evaluation of students' knowledge in the conditions of distance learning during the war are revealed, the recom-?endations for the improvement of the estimation adequacy are given and the examples of test tasks, the use of which will allow us to achieve this goal, are suggested.*

Key words: wartime education, distance learning, evaluation of students' learning achievements, mathematical subjects.

Introduction. Due to the rapid development of computer communication technologies, distance learning is becoming an increasingly popular and widespread form of knowledge acquisition. And at the present time, under martial law on the territory of our state, distance learning has become almost the only possibility of providing educational services to higher education applicants [1 p. 7-8; 2, p.185; 3; 4, p. 57; 5, p.101; 6; 7, p. 130]. Therefore, the issues of ensuring the quality of distance learning, in particular, the problems associated with objective assessment of students' learning achievements in a complex environment come to the fore.

Analysis of recent research and publications. The chosen topic of the study attracts the attention of many scientists, in particular, the issues of control and evaluation of students' learning achievements were considered in the works of such scientists as A. Aleksiuk, Sh. Amonashvili, S. Vitvytska, V. Davydov, A. Zilberstein, V. Yevdokimov, S. Rubinstein, N. Sorokin, N. Talysina and others. Modern approaches to control organization were studied by V. Bocharnikova, I. Bulakh, L. Dobrovska, V. Ilyina, E. Luzik, A. Mokrova, I. Romaniuk and a number of foreign scientists [8, 9].

Objectives of the study:to investigate the pedagogical and psychological problems of assessing students' knowledge of mathematical disciplines during distance learning in general and in the conditions of martial law in particular; propose test tasks, the use of which will ensure the objectivity of the assessment.

Research methods. To achieve the goal, theoretical methods are used (analysis of psychological-pedagogical and methodical literature on the researched problem, working programs in mathematical disciplines), empirical methods (observation of the educational process of students, analysis of their achievements, conversations with students and teachers, study of best practices of teachers).

Presenting main material. Organization of the educational process during the war is not an easy task that faced the educators of our country in the spring of 2022. Currently, institutions of higher education, which are able to

continue the educational process, already have certain achievements and a general vision of the organization of the educational process in the conditions of martial law. But there are still many questions about the optimal combination of the safety of education and the quality of the provision of educational services. Undoubtedly, the synchronous mode of training has more advantages than the asynchronous mode. But in the event of an air alert, interruptions in the supply of electricity or connection to the Internet, asynchronous mode must be used.

Control measures are a necessary element of feedback in the learning process to determine the compliance of the level of knowledge, skills and abilities acquired by students with the requirements of regulatory documents and ensure timely adjustment of the learning process. The main functions of evaluating students' educational achievements are: controlling, educational, diagnostic-corrective, stimulating-motivational and educational [10, Art. 148-149].

During the transition to remote teaching of mathematical disciplines, such types of ongoing control as solving examples by the student at the blackboard and performing independent work in the classroom under the direct supervision of the teacher became impossible. That is, precisely those types of control that allow limiting the student's use of external assistance. It is difficult for most students to organize the solving of problems and examples in practical classes during a video conference, as it requires them to have special devices for input-?ing graphic information or the ability to use a computer mouse for such needs, which is quite inconvenient. In the conditions of war, when students quite often do not even have the opportunity to connect to video conferences, the problem of evaluating their educational achievements has become even larger.

It is clear that the objectivity of assessing the level of students' knowledge during asynchronous control measures is questionable, because when performing tasks in this mode, students have ample opportunities to use the help of classmates, friends or acquaintances, as well as various Internet resources that directly or indirectly offer and provide such assistance. The overwhelming

number of teachers, with whom the authors had the opportunity to communicate, noted the problem of objective assessment of student knowledge based on the works sent to e-mail as one of the key ones and one that does not have a simple solution. An anonymous survey of scientific and pedagogical workers and students of higher education institutions, conducted by the State Education Quality Service of Ukraine from 04/23/2020 to 05/05/2020, also showed that that every third respondent admits the possibility of biased assessment [11, p. 11, 18].

In particular, scientific and pedagogical staff of the Department of Higher Mathematics of the National Aviation University (NAU) have repeatedly encountered cases when a student during a video conference could not answer simple questions of the teacher, and the works sent by him for verification on the same topic were performed flawlessly. There were also situations when a student submitted a work for review in which quite complex tasks were correctly completed, the formulations of which are typical, for example: calculate the value of the boundary of a function, find the derivative of a function, solve a differential equation, etc., and at the same time they were not completed at all or incorrectly solved simple problems with atypical wording.

It is clear that such works caused teachers, at least, doubts about the academic integrity of individual students, which had to be confirmed or denied in personal conversations with them. This created an additional psychological burden on both the teacher and the student, and also took a lot of time. On the other hand, the study of mathematical disciplines by students of technical and economic specialties is an important basis for mastering the future profession, therefore the adjustment of the educational achievement evaluation system has become necessary to ensure its functions.

The distribution of the number of points for individual types of a student's educational work is determined by the work programs of the corresponding disciplines. In particular, for the mathematical disciplines taught to full-time students at the National Aviation University before the transition to the distance

mode, the majority of points were assigned to classroom-based learning activities. After the transition to learning with the help of distance technologies, a large number of teachers were forced to shift the emphasis of current and modular assessment criteria to develop rational and optimal approaches to assessing students' knowledge. Thus, according to survey data, more than 60% of teachers noted that the distribution of points has changed to some extent (completely, partially, or with a preference for evaluating students' independent work) [11, p. 20]. But, from the point of view of the authors,

Department of Higher Mathematics annually monitors students' achievements within the framework of the Quality Management System, implemented in the National Aviation University. After the end of the academic term, the information is collected on the semester grades received by all first- and second-year full-time students studying mathematical subjects, and performance indicators are calculated, in particular, the average score on the national scale, absolute performance (Abs.academ.perf) and quality of performance (Qual.academ.perf) according to the formulas:

$$\text{Absolute academic performance} = \frac{n_1+n_2+n_3}{n-n_н} * 100\%$$

$$\text{Quality of academic performance} = (\frac{n_1+n_2}{n-n_4} * 100\%,$$

where n_1 - is the number of students in the group who received a grade of "excellent";

n_2- the number of students in the group who received a "good" grade;

n_3- the number of students in the group who received a "satisfactory" grade;

n - the total number of students in the group;

n_4 - the number of students who were not allowed to take the exam.

It should be noted that each year the Department provides fundamental training of about 2500 students with higher education degree "Bachelor" full-time and

part-time economic and technical specialties in a full range of mathematical subjects: "Higher Mathematics", "Probability Theory and Mathematical Statistics", "Higher Applied Mathematics", "Linear Algebra and Analytic Geometry", "Mathematical Analysis", "Numerical Methods", "Differential equations and their systems", Probability Theory and Statistical Modeling in Avionics", "Mathematical Modeling of Transportation Processes". Every year the monitoring of academic achievements of the students is realized for the first and second year students of the full-time form of studying technical and economic specialties. About 1770 people are involved in odd semesters and about 800 in even semesters.

Figure 1 shows a histogram of the distribution of grade score average in odd (1) and even (2) semesters during the 2015/2016 through 2020/2021 academic years, and Figures 2 and 3 show the histograms of absolute academic performance and quality of academic performance, respectively.

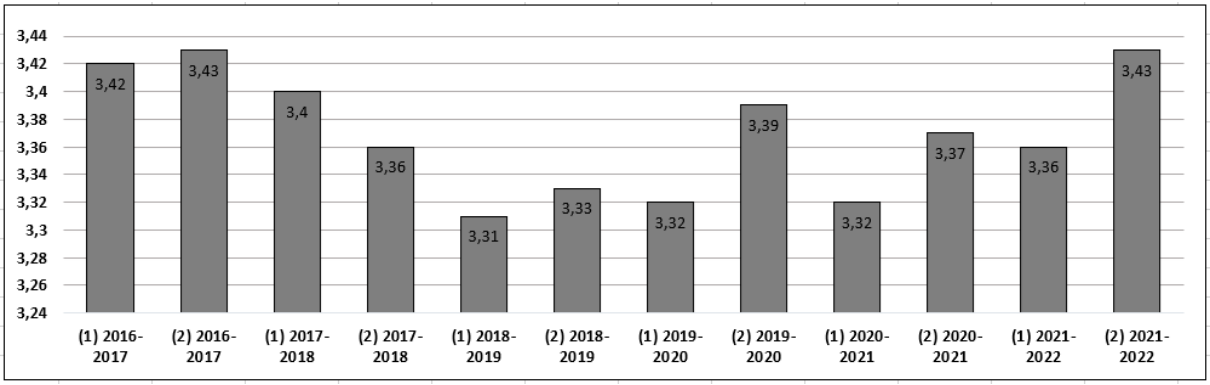

Figure 1. Average score

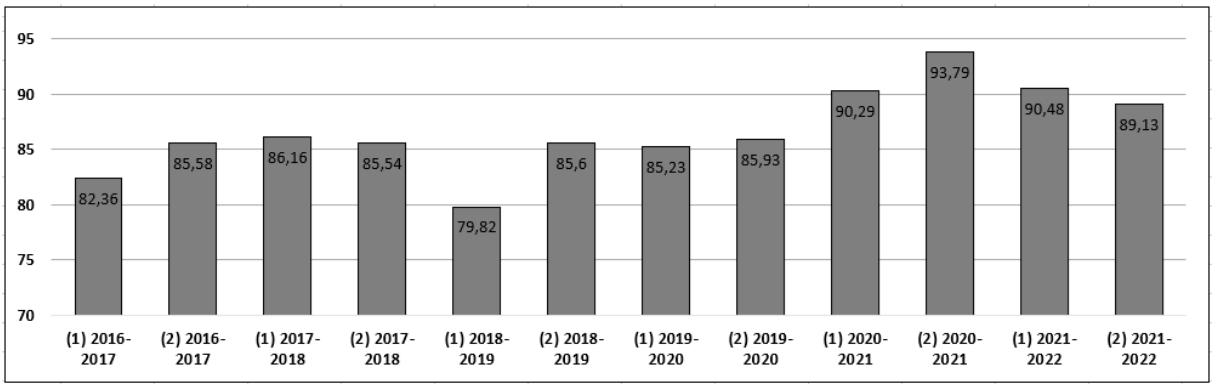

Figure 2. Absolute academic performance

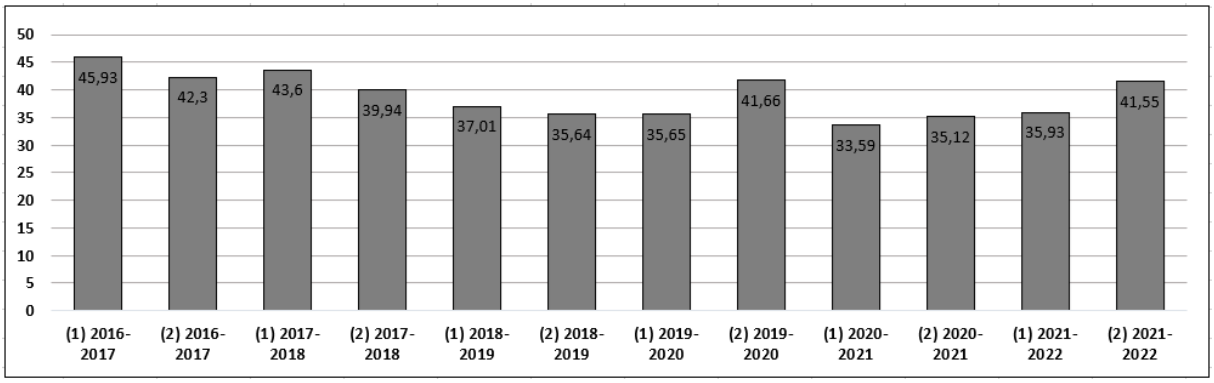

Figure 3. Quality of academic performance

As we can see in Fig.1, after the transition to remote learning in the second semester of 2019/2022 the average score of students increased from 3.32 to 3.39, that is by 0.07 points, which is the largest positive difference between the first and second semesters of the studied academic years.

As stated in [1, p. 262] the transition to remote learning in general had a negative impact on students' attendance and systematicity of their studies. Many students began to learn worse, it became evident in individual communication with the teacher, but, as we can see, the histogram indicates the opposite. Consequently, we can assume that the assessment was biased. Overall, the histogram demonstrates a downward trend in the average level of students' knowledge in mathematical subjects, which is primarily due to the weak level of mathematical training of school leavers. At the same time, Figure 2 indicates a rapid increase in the absolute performance of students during the last three semesters in which the study was remote. This is due, unfortunately, not to an increase in self-control of education applicants and their desire to learn, but again with a shift in the emphasis of individual communication of the teacher and the student to the assessment of the works sent to check, which had a negative impact on the objectivity of grades. The grade quality histogram in Fig. 3 also indicates an overestimation of grades in the second semester of 2019/2020 after the transition to remote learning, although there was an overall decrease in the quality of student

achievement during the period studied. Consequently, the problem with remote assessment of students remains relevant and requires the search for new methods and means of its solution.

It should be noted that the transition to remote learning caused not only problems in the provision and receipt of educational services. A positive consequence was that the system of students' knowledge control in a remote learning environment has been given ample opportunity to use automated control systems, which significantly saves time spent by the teacher on assessing students' knowledge compared to traditional methods of control.

In the work [12, p. 1] a computer-oriented method of assessing the quality of tests in higher mathematics by teachers of higher education institutions is considered. It is indicated that today the central place among methods of knowledge control is occupied by testing. The main advantages of computer evaluation of students' educational achievements are: automation and efficiency of processing test results; acceleration of feedback based on test results, which enables the student to independently identify gaps in the structure of his knowledge and take measures to eliminate them; ensuring the objectivity of the assessment; the ability to regularly replenish and modify the system of test tasks; releasing the teacher from performing routine work. The importance of using tests as a tool for assessing the quality of knowledge and optimizing the educational process is emphasized in works [13, p. 166, 14, p. 5]. Despite the advantages of testing, the application of tests in higher mathematics for students of technical specialties has not yet become large-scale in practice for the following reasons: teachers' attachment to traditional control methods and distrust of test results; insufficient integration of test control technologies in the processes of training and certification of students; test control requires the provision of a computer base for its implementation; in order to test a large number of students, it is necessary to create a powerful database of test tasks. In this connection, there is a need to find ways to improve the quality of tests. the

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In the work [15, p. 54] it is noted that on-line electronic control of knowledge is the basis for obtaining an objective independent assessment of the level of educational achievements of applicants (knowledge, intellectual abilities and practical skills). This type of control is very popular abroad and is being actively implemented in the educational technologies of our country. Today,

there are many platforms that allow you to create tests of various types, for example, Google Forms, Quizlet, Proprofs, Kahoot!, Classmarker, Plickers, Easy Test Maker, Online Test Pad. On the other hand, for this type of control, there is a need to develop a large number of tasks, which causes teachers to be overloaded with technical work. Taking tests containing formulas and graphic data, without which it is impossible to thoroughly check a student's knowledge of mathematical disciplines, takes a particularly long time. Also, teachers should approach the content and form of test questions creatively so that the perfo-?mance of the test is not limited to the student reproducing the theoretical material studied or solving typical problems and examples, which can lead to copying answers from open sources of information, but would encourage the student to think logically , synthesis of acquired theoretical knowledge and practical skills and their application to solving various problems, in particular, of an applied nature. You should especially avoid tasks that can be performed with the help of on-line calculators, of which there are quite a few on the Internet, and which offer not only a step-by-step solution to the task, but also comments and links to the relevant formulas. so that the performance of the test is not reduced only to the student's reproduction of the studied theoretical material or the solving of typical problems and examples, which can lead to copying answers from open sources of information, but would encourage the student to think logically, synthesize the acquired theoretical knowledge and practical skills and apply them to solving various problems, in particular, of an applied nature. You should especially avoid tasks that can be performed with the help of on-line calculators, of which there are quite a few on the Internet, and which offer not only a step-by-step solution to the task, but also comments and links to the relevant formulas. so that the performance of the test is not reduced only to the student's reproduction of the studied theoretical material or the solving of typical problems and examples, which can lead to copying answers from open sources of information, but would encourage the student to think logically, synthesize the acquired theoretical knowledge and practical skills and apply

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Another important aspect of training during the war is the psychological state of the participants in the training process. The stress that all residents of Ukraine are under can negatively affect the ability to learn new material and motivation to study in general. In particular, it is important to organize the assessment of students in such a way as to minimize possible stress for them due to deadlines for completing assignments, problems with Internet connection, etc., and also to reduce the physical burden on teachers when checking papers.In the conditions of martial law, it is important to organize the test so that the student can pass it at a time convenient for him during the time period determined by the teacher, but, at the same time, the duration of the test and the number of attempts should be limited for the objectivity of the assessment.The teacher can also organize students' self-evaluation of their performance, providing them with the correct answers and solutions for self-checking after completing the work.

Here are examples of test questions, which, according to the authors, meet the specified requirements and allow you to find out the level of knowledge of students.

1. To increase the value of the determinant by 2.5 times, it is necessary to:

a) multiply all its elements by a number $^5/_2$

b) add a number to each of its elements $^5/_2$;

c) multiply the elements of any line by the number 5;

d) multiply the elements of any row by number 5 and then divide the elements of any column of the resulting determinant by number 2;

e) multiply the elements of any row by the number $^5/_2$, and then transpose the resulting determinant.

2. The derivative of which of the following functions may be zero at some point:

a) $y = \frac{1}{x}$; b) $y = \ln x$; c) $y = 2\sqrt{x}$; d) $y = ln\, x^2$; e) $y = x\sqrt{x}$?

3. For which values of the variable *a* the inequality holds:

$$\lim_{x\to 0} \frac{\arcsin^2 4ax}{1-\cos 2x} \geq \lim_{x\to 2} \frac{\sqrt{x-1}-1}{x^2-4}\ ?$$

a) $[-1;1]$; b) $[-\infty;-1] \cup [1;+\infty]$; c) $[1;+\infty]$ d) $[-4;4]$;

e) $[-\infty;-4] \cup [4;+\infty]$

4. The divergent non-collinear integral of the second kind is the integral:

a) $\int_e^{\infty} \frac{dx}{x\sqrt{\ln x}}$; b) $\int_0^1 \ln x\, dx$; c) $\int_0^1 \frac{xdx}{\sqrt{1-x^2}}$; d) $\int_{-1}^1 \frac{dx}{x^2}$; e) $\int_1^6 \frac{dx}{1+\sqrt{3x-2}}$.

An example of problems that cannot be found solved on the Internet are the problems given in the methodological recommendations for students' individual work "Higher Mathematics. Probability Theory. Random Events", developed by teachers of the NAU Department of Higher Mathematics [17]. The tasks have an

applied character and modern aviation topics, which helps to increase students' motivation for studying this section of probability theory.

It is also important during the test to limit the time for passing the test and the inability to pass it repeatedly, especially if at the end of the test errors are pointed out and correct answers are given. In Recommendations on organization of current, semester control and attestation of professional higher and higher education with application of remote learning technologies (Letter of MES No.1/9-249 of 14.05.20) [18, art. 1] it is indicated that the control measures of the training process with application of remote learning technologies must meet the following requirements

- authorized access to information and communication tools of remotelearning organization;

- the possibility of determining the start and end time of access, the duration of the tasks;

- objectivity of criteria for checking the results of performance with the active use of automated means of knowledge assessment;

- variability of forming the tasks of control measures (using algorithms of random selection of questions).

Consequently, it is better to organize the current and especially the final control through video conferencing with video fixation, limited time of performance and reduction of points for its exceeding. In addition, for video fixation all students in the group need to have the appropriate equipment and it is almost impossible to implement in large groups of students.

Conclusions

The control of the knowledge and skills obtained by the student is an important component of the educational process. Methods for assessing the knowledge of students who study remotely during the war should be different from those of full-time students. The main ways to improve the objectivity of

assessing learning achievements in the teaching of mathematical subjects are: a creative approach of teachers to create test tasks for all kinds of control, which cannot be done by calculators online and found ready-made on the network; development of small tests that automatically determine the level of student knowledge and allow for ongoing monitoring more often, which will have a positive impact on the objectivity of evaluation, as well as encourage students to study systematically; conducting This will contribute to the eradication of the phenomenon of academic dishonesty and increase the level of mathematical training of future specialists.

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