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DEVELOPMENT OF ORAL MATHEMATICAL SPEECH DURING MATHEMATICAL BATTLES

Abstract*: in the aspect of the problem of the development of oral mathematical speech of students, complex regional mathematical games "Mathematical battles" are discussed. The structure of the games themselves is presented, examples of possible tasks offered at various rounds of games are given. The expediency of mathematical battles in the formation of the regional Olympiad movement is demonstrated. Situations arising in the course of conducting mathematical games «Mathematical battles», through which oral mathematical speech is formed and developed, are listed.*

Abstract*: key words: mathematical Olympiad; mathematical battles; olympiad movement; oral mathematical speech; development of communications; oral communication; development of speech.*

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РАЗВИТИЕ УСТНОЙ МАТЕМАТИЧЕСКОЙ РЕЧИ В ХОДЕ ПРОВЕДЕНИЯ МАТЕМАТИЧЕСКИХ СРАЖЕНИЙ

***Аннотация**: в аспекте проблемы развития устной математической речи обучающихся обсуждаются комплексные региональные математические игры «Математические сражения». Представлена структура проведения самих игр, приведены примеры возможных заданий, предлагаемых на различных турах игр. Демонстрируется целесообразность математических сражений при формировании регионального олимпиадного движения. Перечислены ситуации, возникающие в ходе проведения математических игр «Математические сражения», посредством которых формируется и развивается устная математическая речь.*

***Ключевые слова**: математическая олимпиада, математические сражения, олимпиадное движение, устная математическая речь, развитие коммуникаций, устная коммуникация, развитие речи.*

One of the characteristic features of the life of modern youth is the orientation towards the use of modern information technologies in everyday communication and solving various problems. Without denying the usefulness of this approach in terms of saving time, access to various information resources and other advantages, we have to admit that the lack of live communication forms a kind of sign communication, in which there is no place for the development of professionally significant oral speech. As a result, even students with outstanding abilities in certain scientific fields have poorly formed skills necessary for successful scientific activity – presentation of their theoretical positions available to the audience, competent support for discussion, opposition to reports, conviction in the correctness of their views, scientific research in collective research. The situation is aggravated by the fact that the types of state certification in the form of testing are carried out, which reduces the requirements not only for the development of oral speech of students, but also for the written justification for solving problems, the correct use of subject symbols, and the logic of the solution. An attempt to correct this gap at the stage of university education by increasing attention to frontal oral questioning in classrooms, the work of students at the blackboard, oral colloquia, tests and exams can only partially remove the problem. As a result, it is

necessary to state the fact of the need for out-of-class forms of work with students aimed at developing oral communication.

One of such forms can be confidently considered “Mathematical Battles” – regional mathematical games, held since 2017 as part of the Olympic movement in the Kaliningrad region [1]. Traditionally they are held in 4 rounds. Team meetings are held four times on different days. Let us briefly present the main stages of the game and the possibilities of these stages for the development of oral mathematical speech (and hence the development of scientific speech, since mathematics, due to its subject specificity, provides general intellectual development).

Round 1 (first day). Presentation of teams (teams participate in the competition for the name, motto, team logo). Brain ring teams.

When presenting teams, the humor and brevity of the team name and its attributes are taken into account. In particular, many participants remembered the highly intelligent and extraordinarily thinking Sharp Angle team of 2017 with a very simple emblem and a two-digit slogan-motto causing slight bewilderment: “An acute angle is an acute angle, because it is not obtuse”. Despite the apparent uselessness of this part of the tour, it forms an important skill – to start verbal contact, enter a communication situation, win over the interlocutor (in this situation, an opponent), demonstrate the requirements of respect for yourself and your environment.

The problems of the first round presuppose a quick solution and the victory goes to highly reactive players who are good at basic theoretical material and basic ingenuity. The tasks here can be quite varied. The first type is “serious”. Example: find the probability of falling on the interval (2; 3) of a random variable with the distribution function $F(x) = 2^x$ (the probability is 0, since on this interval $F(x) = 2^x > 1$ and cannot set the distribution function of a random variable on it). The presentation of the solution to the problem involves the articulation of the main theoretical arising from the definition of the concept. The second type is “semi-serious”. Example: three chicks flew out of the nest, after what time will they fly in the same plane? The correct answer is that the chicks immediately find themselves in the same plane, since three points define the plane. Knowledge of basic definitions is also important here. The third type

is “joke tasks”. Example: a fourteen-story building has an elevator. There is only one apartment on the ground floor and a married couple lives in it. The number of residents on each floor up to the eighth floor increases in arithmetic progression, and from the ninth floor decreases exponentially. Which elevator button is pressed most often? The answer is the “1” button, which denotes the first floor, regardless of the number of residents. Solving such problems forms an important skill – to analyze the condition of the problem. In terms of the development of oral mathematical speech, the brain-ring makes it possible to train in a short time to exchange opinions and make a collective decision of the team.

In addition to the stage of the brain-ring, the work of universities at the preliminary stage should be noted. The fund of tasks is formed by university teachers and students (cadets). At the same time, tasks for selection for games can be submitted not only by team members, but also by fans. This generally raises the level of students' mathematical training.

When summing up the results, the teams are given the task of making homework for the opponents – a task of 7 problems on a specified topic (Linear algebra, Analytical geometry, Introduction to analysis, Differential calculus of functions of one and several variables, Integral calculus of functions of one and several x variables, Series, Probability theory and mathematical statistics), which are exchanged after the end of the 3rd round.

Round 2 (second day, which is scheduled about a week after the first day). The written tour is teamwork. For a limited time (1.5 hours), the teams solve the same task of 7 problems (the topic is the same as in the homework). The formation of teamwork skills is carried out at this stage in an explicit form. Next, the teams present the solution to the problems on the board with a comment according to the draw (the winner of the previous round starts) and discuss the solution. Opponents are appointed from each team whose task is to identify errors and inaccuracies in solving the opponent's problems and possibly lead the jury to the decision to transfer the presentation of the solution to the other team. Teams at this stage are awarded points not only for solving problems, but also for opposition.

Let's give an example of the second round task.

Task 1. Topic “Linear Algebra”. Solve system of equations

$$\begin{cases} x_1 + 2x_2 + \cdots + 9x_9 + 10x_{10} = 55, \\ x_2 + 2x_3 + \cdots + 9x_{10} + 10x_1 = 55, \\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots, \\ x_{10} + 2x_1 + \cdots + 9x_8 + 10x_9 = 55 \end{cases}$$

Task 2. Topic “Analytical geometry”. On alien terrain of interest to military intelligence, there is a spherical object with a radius of 2 space units of length. The object is illuminated by light sources that together generate a beam of rays parallel to the bisector of the upper right rectangular sector of the object's vertical diametrical section. The presence of the scout in the shadow area of the object is highly likely not noticeable for the protection of the object. Mark the boundary of the safe zone on the terrain map. The surface of the planet in the area of the object is considered flat.

Task 3. Topic “Introduction to mathematical analysis”

$$\lim_{x \to \frac{\pi}{4}} \frac{sin7x\text{-}sin3x}{e^{x^2}\text{-}e^{4\pi^2}}$$

Task 4. Topic “Differential calculus of functions of one or more variables”. Let f and g be non-constant differentiable real functions on R and for any x, y ∈ R the following holds:

$$f(x+y) = f(x)f(y)\text{-}g(x)g(y),$$
$$g(x+y) = f(x)g(y) + g(x)f(y).$$

Let f '(0) = 0. Prove that for any x the following relation holds: $f^2(x) + g^2(x) = 1$.

Task 5. Topic “Integral calculus of functions of one or more variables”. Calculate

$$\int_1^e \sqrt{\ln x}\, dx + \int_0^1 e^{x^2}\, dx.$$

Task 6. Topic “Ordinary differential equations”.

Let the solution $y(x),\ x \in (-\infty, \infty),$ of the differential equation $y'' - 2y' + y = 2e^x$ take values of opposite signs. Show that $y(x)$ it has one minimum and one maximum.

Task 7. Topic “Theory of series”. Find the sum of a series.

$$\sum_{n=2}^{\infty} \frac{(-1)^n}{n^2 + n\text{-}2}.$$

Task 8. Topic “Probability theory and mathematical statistics”. The random variable X takes values from a natural series of numbers, and $P_n = P(X = n) = 2^{-n}, n \in N$.Find the distribution of a random variable Y, M (Y), D (Y) if $Y = Cos\left(\frac{\pi X}{2}\right)$.

Obviously, the tasks of the 2nd round are a fairly typical block of problems for a written Olympiad in mathematics [2]. The peculiarity of the tasks is that the solution should be short enough so that it can be effectively demonstrated on the board without preliminary preparation of demo material. Any team member can submit problems, but each participant cannot submit more than 2 problems. Thus, all team members must be prepared to verbally defend the decision. During a discussion with an opponent, the combatant presenting the problem may request the team's help. In addition to the development of oral speech at this stage, the ability to weigh one's own strengths and take responsibility for the work done together is formed.

Round 3 (third day, held in the same way about a week after the second day). Captains competition. The competition is divided into 2 parts: a blitz of captains and a difficult part. The tour combines in a shortened form the ideology of the first two, but at this stage the captains demonstrate mathematical preparation. At the stage of the difficult part, they solve complex tasks with the teams, but only the captains present solutions. Team members gain the skill of transferring knowledge to an interested person while preparing the captain for the presentation of problem solutions. During the blitz stage, captains can request the team's help, but the points received are reduced.

After summing up the results of the competition, the team captains exchange homework.

A week after the third round, through representatives without a meeting of teams, homework solutions are exchanged to check and evaluate the opposing teams

It should be noted that the homework assignment allows for the attraction of fans. In the course of the work, the ability to work with various sources is practiced, a

collective discussion of the feasibility of including certain materials in the homework, the team prepares a reference solution to the problem, a computer presentation of the solution to be presented to opponents when discussing and analyzing problems and deciding on appeals. When preparing tasks, a variety of sources can be used. Given the difficulties in universities using the Internet, on the playgrounds use a bank of tasks and a number of teaching aids in electronic form, permanently placed in the local computer class [1].

Round 4 (usually two weeks after the third round). This round is the final round. Homework results are summarized. Teams make appeals. At the end of the round, the winners are announced and an award ceremony is held.

Thus, mathematical battles are a long-term complex multifaceted team game that allows you to attract a huge number of students interested in games to your conduct. "Mathematical battles" are games that conceptually correspond to the idea of the Olympiad movement, since they have all its features [3, p. 167–168]: actually various forms of realization of intellectual activity as a form of meetings – blitz competitions, team written round, individual intellectual competition of captains, homework; creative thinking; preparation for participation in the rounds of mathematical battles; uncertainty and competition among participants from rival universities; joint creative activity of the participants in the battles; membership of battle participants in an interuniversity seminar for solving non-standard problems in mathematics and natural sciences; continuous self-education of participants, most clearly carried out during the competition "Homework". Unlike ordinary Olympiads, "Mathematical battles" can effectively shape the development of oral mathematical speech of students.

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