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## ELEMENTS OF PROBABILITY AND DATA IN THE NATIONAL EXTERNAL ASSESSMENT AND MATHEMATICS CURRICULA IN BULGARIA

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**Abstract:** The article examines a specific task (task 6) of the National external assessment in Mathematics at the end of 7th grade, conducted in June 2020. A brief analysis of the performance of students across the country by districts of this task was made. The task itself is in the field of competence "Elements of probabilities and statistics" from the mathematics curriculum for 6th grade. It explores the concept of "probability of a random event" and is analogous to task 7 of the National external assessment in Mathematics in the previous 2018/2019 school year. The competencies are analyzed as expected results from the quality assimilation of the study material. The topic "Elements of Probabilities and Statistics" is part of the new curriculum of Mathematics programs in lower secondary education, which are part of the education reform after the entry into force of the new Pre-school and School Education Act in 2016 in Bulgaria. In the previous 2018/2019 school year, the students, who took part in the External assessment in Mathematics achieved poor performance in a task similar to the one presented. Then it was assumed that the preparation of students on this topic is probably not good or that students are taught to solve certain types of tasks and can not go beyond the framework. Then the questions were raised whether one of the reasons could be the poor presentation of students' learning content by teachers, where they find it difficult to learn the concepts and further difficult to build competencies on the topic. The difficulties of the teachers themselves could be caused by the fact that this new content has not been taught by them so far and they do not feel confident enough to teach it. Another reason is that teachers still do not know how to plan their work well enough and continue to teach verbatim in textbooks, without considering whether the textbooks offer does not exceed the content of the curriculum, and students in most cases have no interest in the subject and have significant knowledge gaps from previous years. Thus, every school and every teacher had to look for the reasons for the achieved results of the external assessment during the last school year, as well as ways to solve them and take action for the next school year. As a result, in the 2019/2020 school year, the task that tested the concept of "probability of a random event" there was a large percentage of students who answered correctly. It has become a recognizable and expected task, but some of the reasons seek their solution. In recent years, steps have been taken to establish not only the mathematical literacy of students at the end of seventh grade, but also their functional literacy in Bulgarian language. In the coming years, a study of literacy and subjects will be tested, which will participate integrated in the National external assessment for the recent year.

**Keywords:** National external assessment/NEA/, probabilities, 1) Natural and mathematical sciences

With the new Pre-school and School Education Act in 2015, the new state educational standard for general education came into force, as this training is acquired in the course of the entire school education and covers a group of competencies, including mathematics, aimed at mastering mathematical and scientific literacy.

This also determined a change in the philosophy of teaching mathematics and the National external assessment in terms of content – assessment not only of knowledge or skills, but also of competencies. "Mathematical literacy plays a key role in the personal and professional development of students" (Staribratov, 2018).

In the curricula and in the models of national external assessment the competencies of the students are specified as expected learning outcomes.

In the curricula for general education and in the model for National external assessment there is an area of competence "Elements of probabilities and data", defined by Ordinance № 5 for general education. The competencies as expected learning outcomes are:

- For sixth grade – a student is able to find a subset of a set and section and union of sets, knows the concept of a random event at the simplest level (coin, dice) and is able to calculate the probability of a random event at the simplest level; (MC 6).
- For seventh grade - a student is able to assess the probability of outcomes of a random nature and uses the chance (probability) for a particular outcome in tasks. (MC 7).

The model of the National external assessment identifies topics from the curriculum in this area of competence (Model 7):

- Presentation, reading and interpretation of data presented through diagrams and graphs;
- Sets and operations with them;
- Random event. Probability of a random event

In June 2020, the National external assessment in Mathematics took place for students who are in seventh grade in the 2019/2020 school year. This is the second class, which in the lower secondary (basic) education is trained in the new curricula in Mathematics.

According to the model of the National external assessment in Mathematics (Model 7) published on the website of the Ministry of Education and Science, part of the objectives of the NEA according to Art. 44, para. 1 of Ordinance № 11 for evaluation of the results of the students' education are identical with the goals of the NEA in the previous school year:

1. "Establishing the degree of achievement of separate expected results from the teaching of mathematics, determined in the curriculum for the recent class;
  2. Establishing the degree of achievement of individual expected learning outcomes at the end of the lower secondary stage in Mathematics, defined in the state educational standard for general educational training." (NEA 7)
- Task 7 and Task 6 of the conducted National external assessment in Mathematics at the end of 7th grade in 2018/2019 and 2019/2020 school years establish the degree of achievement of the expected result regarding the concept of "probability of a random event", which is studied for the first time in the curriculum for sixth grade in Mathematics:

The condition of task 7 of the NEA in 2019 is: The probability of a dice falling a prime number is: A) 0 B)  $\frac{1}{3}$  C)  $\frac{1}{2}$  D)  $\frac{2}{3}$  (NEA 7).

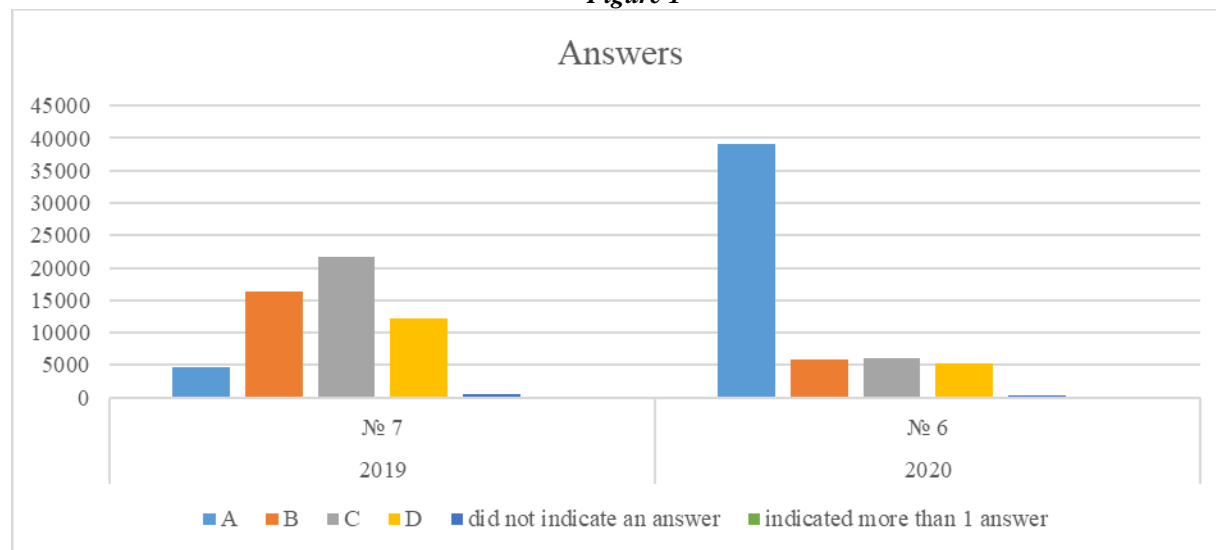
The condition of task 6 of the NEA in 2020 is: Onto each of the seven identical cards is written one of the seven letters of the word УЧЕБНИК/TEXTBOOK. The cards are placed in an urn. One of them was downloaded at random. What is the probability that a letter denoting a vowel sound is written on it? A)  $\frac{3}{7}$  B)  $\frac{4}{7}$  C)  $\frac{6}{7}$  D) 1 (NEA 7).

In 2019, 55474 students from all over the country took part in the NEA, and in 2020 – 56765. Their answers are distributed as follows:

**Table 1**

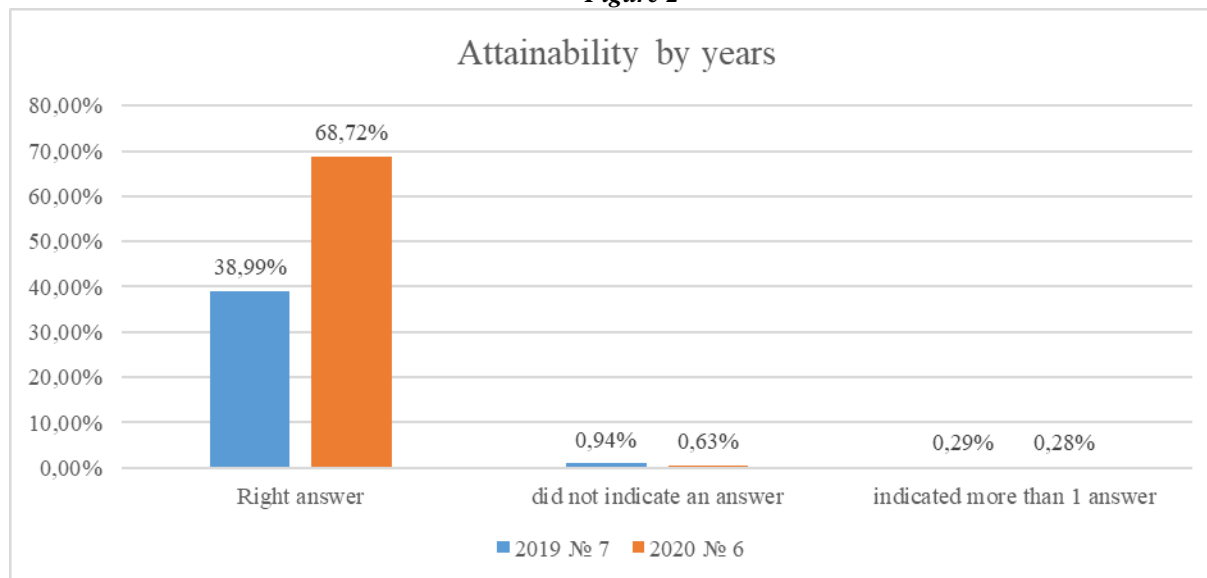
Year	Task	A	B	C	D	did not indicate an answer	indicated more than 1 answer
2019	№ 7	4607	16316	<b>21629</b>	12238	523	161
2020	№ 6	<b>39007</b>	5920	6148	5176	357	157

**Figure 1**



In 2020, the correct answer A) was indicated by 39,007 students, which is 68.72% of the number of participants, while last year the correct answer C) was indicated by almost 39% of the number of participants. It is noteworthy that the percentage of those who did not indicate an answer (0.94% and 0.63%), as well as those who (0.29% and 0.28%) is almost preserved.

**Figure 2**

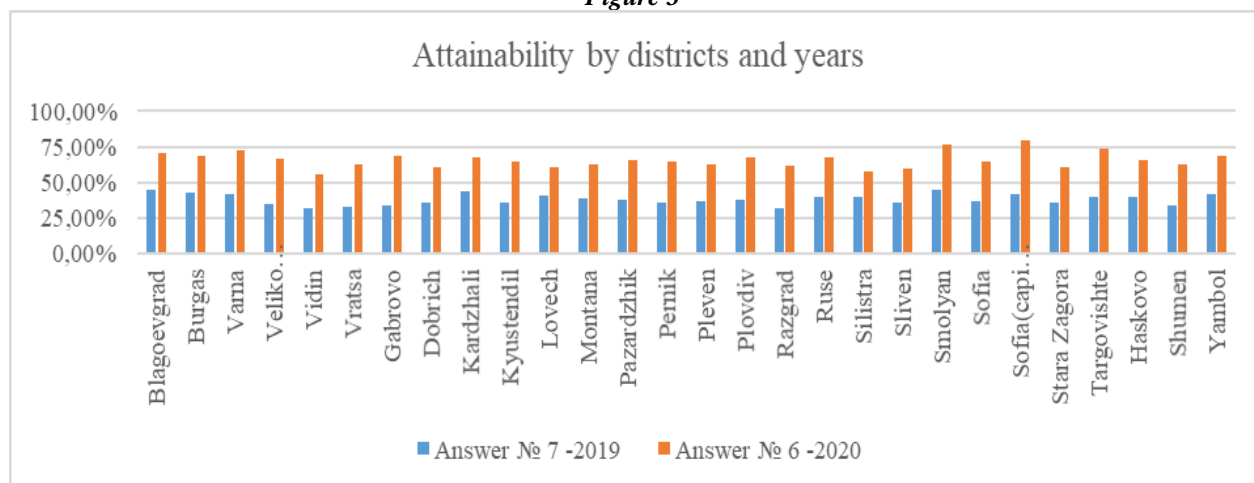


The probability of a random event in the National external assessment in Mathematics in 7th grade in 2020 has already been determined by more than half of the participants, unlike in the previous year.

The percentage of respondents through the other distractors is interesting - their choice suggests that some students have not mastered the concept of "loud sound", which is from the Bulgarian language curriculum. The task makes a step in the interdisciplinary assessment of students' competencies, unlike the previous year, where competencies from the stage of teaching mathematics are assessed (the concept of prime number is studied in the 5th grade).

The distribution of the percentage of correctly answered students by areas of the country of the tasks is as follows:

**Figure 3**



The diagram shows that in all districts of the country there is an increase in the average score compared to the task in the same area of competence in the previous year - for example in Sofia district the result increased by 38.41% and the smallest increase was in Silistra district (18.23%).

It can be concluded that this element of the curriculum and the model of NEA after the first year is recognizable by teachers and students in their preparation and at the same time shows that as a new part of the curriculum in Mathematics is well perceived and assimilated by students. However, National external assessment still contains in

the most part tasks that reproduce concepts and students do not have to describe or explain a phenomenon. Another reason for the results of the national external assessment in mathematics is that teachers still do not know how to plan their work well enough and continue to teach verbatim in textbooks, without considering whether the textbooks offer does not exceed the content of the curriculum, and students in most cases have no interest in the subject and have significant knowledge gaps from previous years. In recent years, steps have been taken to establish not only the mathematical literacy of students at the end of seventh grade, but also their functional literacy in Bulgarian language. In the coming years, a study of literacy and subjects will be tested, which will participate integrated in the National external assessment in the end of 7th grade for the recent year.

### CONCLUSION

Mathematical literacy includes mathematical reasoning and the use of mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It allows the student to think, use and interpret mathematics to solve problems and real situations by knowing and understanding concepts, facts and tools (PISA, 2021). But at the same time "For the good mastering of mathematical concepts and development of competencies of the greatest importance is the pedagogical approaches of teachers and their professional training" (Staribratov, 2019). Then the question arises what methods and approaches teachers use in teaching mathematical literacy and for acquiring competencies in students of this age...

### LITERATURE

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