

STATEMENT REPORT

**Under the procedure for acquisition of the educational and scientific degree
“Doctor”**

By candidate Pavlin Ivanov Tsonev

of the PhD Thesis entitled: “Methods for analysis of results of standardized student assessments in mathematics”,

In the Scientific field: **1. Pedagogical Sciences,**

1.3. Pedagogy of education in ... (mathematics)

Doctoral program “: "Methodology of the Teaching of Mathematics and Informatics – Methodology of the Teaching of Mathematics”, Department „Education in Mathematics and Informatics”,

Faculty of Mathematics and Informatics (FMI), Sofia University “St. Kl. Ohridski” (SU),

The statement report has been prepared by: Prof. (retired) DSc Jordan Borisov Tabov (IMI-BAS) as a member of the scientific jury for the defense of this PhD thesis according to Order № ПД 38-118 / 6.03.2025. of the Rector of the Sofia University.

1. General characteristics of the dissertation thesis and the presented materials

The dissertation of Pavlin Ivanov Tsonev is 219 pages long. It consists of an introduction, three chapters, a conclusion, 8 appendices and a bibliography of 45 titles. It has 105 figures and 103 tables. The publications based on the dissertation’s research are 6, and in them the PhD student is the sole author. The most prestigious of them are two articles in the journal "Mathematics and Informatics", which is refereed and indexed in Web of Science, and a report of the conference of the Union of Mathematicians in Bulgaria, whose collection of scientific articles is refereed and indexed in Scopus. Two others are from conferences of the Georgi Benkovski Higher Air Force School, and one was reported at an international conference in Romania.

2. Short CV and personal impressions of the candidate

Pavlin Tsonev graduated in 1994 from Sofia University "St. Kliment Ohridski" – Sofia with a degree in "mathematician" and a second specialty - "teacher of mathematics". In 2006 he specialized at IMI-BAS "Modern education with dynamic mathematics software GEONeXT", and in 2019 at Sofia University "St. Kliment Ohridski" has acquired the

qualification of "evaluator of test tasks in mathematics". After 1994 he has been a teacher in various schools and cities, and from 1995 to 2000 and from 2020 until now he is an assistant at the Georgi Benkovski Higher Air Force School Dolna Metropolia. D. Metropolia. These data indicate extensive professional experience related to teaching and assessing knowledge in mathematics.

Content analysis of the scientific and applied achievements of the candidate, contained in the presented PhD thesis and the publications to it, included in the procedure

The research described in the dissertation is related to the analysis of the results of National External Assessments (NEAs) in Bulgaria. The introduction presents a discussion of the relevance of the problem, a reference to the origin of the NEA and a quantitative comparison of their evolution in terms of the number and type of tasks in them. The need for a statistical analysis of the different editions of the NEA is justified. Problems that need to be investigated are formulated: for the interpretation of the results of Bulgarian students – whether they meet the state educational requirements; whether the tasks of the NEA fulfill the goals they expect, how are the NEA used for changes in curricula. whether it is correct to use NEA for admission to high schools. The author argues that the use of classical test theory in combination with probabilistic modeling methods (in particular, Item Response Theory) will give a more accurate assessment of the achievements of Bulgarian students in mathematics.

The first chapter presents a description of the types of assessment of the characteristics of classical test theory, of some types tests, of the characteristics of tasks such as difficulty, discrimination and analysis of distractors, of the concepts of reliability and Cronbach's alpha. An analysis of tasks from the National External Assessment for Grade VII from 2020 has been made and two options for transforming the test score into a six-point scale have been proposed. The test tasks were examined for difficulty – two were easy, one was difficult, one was very difficult, and the rest were optimal. Their discrimination is also evaluated – with a good assessment. An important problem is noted: the test does not give a precise ranking in high schools after VII grade. Similarly, an analysis of the tests for NEA after VII grade from 2021, 2022 and 2023 is presented, and some differences between them are presented.

The second chapter presents an alternative reading of the results of the NEA through probabilistic modeling. It is shown how to some extent the factor of "difficulty of the tasks" can be suppressed and the test scores can be influenced: if the level of students over the years begins to drop, but at the same time they are given relatively easier tasks, then according to the classical theory of tests, the decline in results may remain hidden.

A study of the results of the NEA from 2020 to 2023 was made, which showed that the NEA in 2022 had a bad coefficient of difficulty of the tasks. Of great importance is the established decrease in student achievements during the studied period 2020-2023, which differs from the official statistics, which, based on the classical test theory, does not report such a result. This, in my opinion, is the greatest contribution of Pavlin Tsonev's dissertation. The discrepancy between the difficulty of the tasks and the management for their assessment in the NEA from 2020 to 2023 is also highly appreciated – some objectively difficult tasks were evaluated with fewer points than others that were easier.

Chapter 3 describes a pedagogical experiment among 487 students from 9 regional cities in order to apply and compare the methods of classical test theory and probabilistic modeling when conducting two different NEA in mathematics after VII grade on the same group of students. Conclusions were drawn from the experiment, which were formed as recommendations to the future compilers of the NEA – four specific recommendations regarding the multiple-choice tasks, three recommendations regarding the extended free answer problems and five recommendations regarding scoring. These recommendations are a significant applied contribution of the dissertation. The conclusion logically summarizes the entire work. After the conclusion, a series of scientific and applied contributions is traditionally presented. I have some remarks about some of them, which will be reflected in a separate paragraph. This is followed by a list of sources from the literature used and a list of publications related to the dissertation.

3. Approbation of the results

The publications on which the dissertation is based are 6 in number, and in them the PhD student is the sole author. Two of them are articles in the journal "Mathematics and Informatics", which is referenced and indexed in Web of Science, one is a report of the conference of the Union of Mathematicians in Bulgaria, whose collection of scientific articles is refereed and indexed in Scopus, two others are from conferences of the Georgi Benkovski Higher Air Force School, and one is reported at an international conference in Romania. Thus, the scientific works meet the minimum national requirements (under Art. 2b, para. 2 and 3 of ADASRB*) and respectively to the additional requirements of Sofia University "St. Kliment Ohridski" for acquiring the educational and scientific degree "Doctor" in the scientific field and professional field of the procedure; the results presented by the candidate in the dissertation work and scientific works to it do not repeat (it is explained which and to what extent) such from previous procedures for acquiring a scientific title and academic position; there is no plagiarism proven in the legally established order in the submitted dissertation work and scientific papers under this procedure.

4. Qualities of the abstract

The abstract reflects the content of the dissertation and meets the usual requirements.

5. Critical notes and recommendations

In my opinion, in the dissertation and the accompanying papers, it would be good to mention the problems arising from the fact that students are stimulated by the assessment rules to indicate as correct one answer to all problems (including the unsolved ones), thus gaining the probability of receiving a higher grade than they are entitled to the problems actually solved. I recommend Pavlin Tsonev to continue his research with the same attitude to the theory, practice and results of NEA as presented in the dissertation.

6. Conclusion

Having become acquainted with the PhD thesis presented in the procedure and the accompanying scientific papers and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, I **confirm** that the presented PhD thesis and the scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the requirements of the Act on Development of the Academic Staff in the Republic of Bulgaria, the Rules for its Implementation and the corresponding Rules at the Sofia University "St. Kliment Ohridski" (FMI-SU) for acquisition by the candidate of educational and scientific degree "Doctor" in the Scientific field 1.3. Pedagogy of education in... (mathematics). In particular, the candidate meets the minimal national requirements in the professional field and no plagiarism has been detected in the scientific papers submitted for the competition.

Based on the above, I **strongly recommend** the scientific jury to award Pavlin Ivanov Tsonev the educational and scientific degree "Doctor" in the Scientific field 1.3. Pedagogy of education in... (mathematics).

Date: 20.03. 2025

Signature:

Jordan Borisov Tabov, professor (retired), DSc