STATEMENT REPORT

In connection with a procedure for the acquisition of the educational and scientific degree "Doctor" by candidate Mladen Georgiev Valkov,
Title of the PhD Thesis: " Development of digital competence by mathematics education",
Scientific field: **1. Pedagogical Sciences**
Professional field: **1.3. Pedagogy of learning in …**
Doctoral program **"Methodology of Teaching in Mathematics, Informatics and Information Technologies"**
Sectiont „ **Education in Mathematics and Informatics**",
Institute of Mathematics and Informatics, Bulgarian Academy of Sciences (IMI-BAS)

The statement report has been prepared by: Prof. Doctor of Mathematical Sciences Petar Stoyanov Kenderov (pensioner) as a member of the scientific jury for the defense of this PhD thesis according to Order № 53/ 27.02.2024 г. Of Prof. Petar Boyvalenkov, Director of IMI-BAS.

1. **General characteristics of the dissertation thesis and the presented materials**. Mladen Georgiev Valkov was enrolled as a full-time doctoral student in the above-mentioned Doctoral program by order No. 1068/20, 12.2018 of the then director of IMI-BAS academic Veselin Drenski. Prof. Dr. Toni K. Chehlarova has been appointed as the scientific supervisor. The official start of the doctoral studies is 01.01.2019. As can be seen from the documents attached to the procedure, Mladen Valkov took, within the time limit set for the purpose, all the exams in the specialty, as well as an English language exam and a presentation skills test. He was dismissed with the right to defense a dissertation by order No. 15/24.01.2022 of Prof. Petar Boivalenkov, Director of IMI-BAS. According to order No. 575/22.12.2023 of the director of IMI-BAS, on 15.01.2024, a pre-defense of Mladen Valkov's dissertation was held. I took part in that meeting. The internal review was prepared and presented by Assoc. Prof. Evgenia Sendova. At the end of the discussions, the proposal to direct the thesis for defense was unanimously supported by the members of the unit (10 votes "YES").

All the documents envisaged by Appendix 4 to the Regulations on the terms and conditions for acquiring scientific degrees and for holding academic positions at the Institute of Mathematics and Informatics of the BAS have been provided. The minimum requirements for obtaining the educational and scientific degree "Doctor", envisaged in Appendix 1 of the Regulations for the conditions and procedures for acquiring scientific degrees and for holding academic positions in the Bulgarian Academy of Sciences, are also satisfied.

The dissertation consists of 215 pages. It has three chapters: *Digital competence: theory and practices; The StruniMa educational system as a tool for the development of digital competence in mathematics education* and *Pedagogical experiment*.

The list of used literature items contains 91 titles, a significant part of which are fundamental and "framework documents" of the European Union, referring to the digital transformation of education, economy, and public life. 38 of the literature items are in Cyrillic alphabet, and the rest are written with Latin letters.

2. Short CV and personal impressions of the candidate

From the documents provided in connection with this procedure and from the personal impressions I have of his activity, it can be seen that the candidate is an outstanding young mathematician and computer scientist with many recorded serious academic achievements. He received his secondary education at the "Nancho Popovich" High School of Science and Mathematics in the city of Shumen. As a student, he participated very successfully in several national and international mathematics competitions, as well as in the activities of the High-School Students' Institute of Mathematics and Informatics. These performances continued during his studies at the Faculty of Mathematics and Informatics of Sofia University (FMI-SU), from where he received a bachelor's degree in Computer Science and a master's degree in the field of Mathematical Optimization. As a student, he participated in research activities in mathematics at FMI-SU. He published (together with Prof. Dr. Nadezhda Ribarska and Mira Bivas) an article in the Proceedings of the Bulgarian Academy of Sciences (Vol. 71, No. 7, pp. 875-884) in the field of optimization (tangent cones and Lagrange multipliers rule).

The affinity for everything related to education seems to be a family trait of Mladen Valkov. His mother Darinka Valkova is a famous teacher with national awards for innovations in education. Even as a student, Mladen Valkov leads classes with students at FMI-SU. At the same time, he worked at the Institute for Progressive Education (JumpMath). Subsequently (and currently) he works as a software engineer, but combines this with the development of innovative learning resources, with the participation in the team for conducting the competition "VIVA mathematics with a computer" and other activities supporting the acquisition of digital competences by students. Of course, when teachers use such resources, their digital competence also increases.

3. Content analysis of the scientific and applied achievements of the candidate, contained in the presented Ph.D. thesis and the publications to it, included in the procedure.

The first chapter of the dissertation simultaneously plays the role of a Literary Reference, but also justifies, stepping on a normative basis originating from the structures of the European Union, the need to master the various aspects of digital competencies. The second chapter, which I believe is the central one, presents the original author's StruniMa system for generating educational video games in which observation, communication, feedback, and evaluation are possible. Opportunities to use augmented and virtual reality are also built-in. Several specific resources have been developed in this environment, which support the study of mathematics and subtly inculcate in learners the basic elements of digital competence. The "School", "Learn" and "Duel" components of this system impress not only with the technical performance but also with the potential for further development and use.
The third chapter presents a Pedagogical Experiment, which is described with appropriate scientific strictness and self-criticism. This experiment shows that the developed resources can be used to develop students' digital competencies through mathematics education.

4. Approbation of the results

There are four publications related to the dissertation:

Chehlarova, T., Valkov, M., (2021). *Game with a vertical axis of symmetry in a rectangular board*. Symmetry: Culture and Science, 32, 2, Symmetrion, 285-288

Chehlarova T., Valkov M. (2021) *Central symmetry on a board*, Pedagogical Forum Issue Four, 2021, DOI: 10.15547/PF.2021.021

Valkova D., Valkov M. (2021) Spices and digital competence in mathematics and information technology education, "Pedagogical Forum" magazine, issue 3, 2021, DOI: 10.15547/PF.2021.018

Valkov M. (2022) Synchronous distance learning in the educational game "StruniMa", E-magazine "Pedagogical Forum", issue 1, 2022, DOI: 10.15547/PF.2022.005.

I have attended conferences and seminars where M. Valkov presented different elements of the system he developed. I have not noticed a negative reaction from the specialists to what he presented.

5. Qualities of the abstract

The abstract correctly and fully reflects the facts and conclusions in the dissertation work.

6. Critical notes and recommendations

I have no significant critical remarks. The focus of the research is on how digital skills and competences can be acquired through mathematics education. This somewhat overshadows the other huge benefit to mathematics education resulting from the use of digital tools and systems. GeoGebra-type systems allow a significant part of the mathematical facts and phenomena studied at school to be learned, explored and even discovered by the learner in a purely experimental way. As it is done in all other natural science disciplines. Therein lies a serious potential for mastering mathematics to the extent of being able to solve applied problems, which is the basis of Functional Literacy, which is sorely lacking among the Bulgarian participants in the PISA educational achievement measurement.

In the list of literary sources, under number 86, the following text is given:
Taylor, M., Harlow, A., & Forret, M. (2010). Using a computer programming environment and an interactive whiteboard to investigate some mathematical thinking.
The coordinates of this article are not specified. However, they are not difficult to find:
Procedia-Social and Behavioral Sciences, 8, 561-570. Online:10.1016/j.sbspro.2010.12.078

Choosing a dark background in most of the created learning environments certainly has some advantages (or satisfies the author's personal preferences), but for people with impaired vision or a tendency to depression, it is a reason for disapproval and even rejection.

7. Conclusion

Having become acquainted with the PhD thesis presented in the procedure and the accompanying scientific papers and based on 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 IMI-BAS for acquisition by the candidate of the educational and scientific degree “Doctor” in the Scientific field **1. Pedagogical Sciences**, Professional field **1.3. Pedagogy of learning in …**In particular, the candidate meets the minimal national requirements in the professional field.

Based on the above, **I recommend** the scientific jury to award Mladen Georgiev Valkov the educational and scientific degree “Doctor” in the Scientific field **1. Pedagogical Sciences**, Professional field **1.3. Pedagogy of learning in Mathematics, Informatics and Information technologies.**

.

Date: 28.04.2024

Signature: .....
/Professor Petar Kenderov/