

REVIEW

by Prof. Galya Mihailova Kozuharova PhD

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of a dissertation for awarding the educational and scientific degree "doctor"
professional direction 1.3 Pedagogy of training

Doctoral program: Teaching methodology in mathematics, informatics and
information technologies

Author: Mladen Georgiev Valkov

Topic: "DEVELOPMENT OF DIGITAL COMPETENCE IN MATHEMATICS
EDUCATION"

Scientific supervisor: Prof. Dr. Toni Chehlarova

1. General description of the presented materials

This review was prepared on the basis of order No. 53/of 27.02.2024 of the Rector of IMI at BAS. With this order, I have been designated as a member of the scientific jury to ensure a procedure for the defense of a dissertation on the topic "Development of digital competence in mathematics education" for the acquisition of the educational and scientific degree "doctor" in professional direction 1.3 Pedagogy of training ..., doctoral program: "Methodology of training in mathematics, informatics and information technologies" with the author of the dissertation work Mladen Georgiev Valkov - doctoral student at the Mathematics and Informatics Education section of IMI, BAS, supervisor Prof. Dr. Tony Chehlarova.

The set of materials presented by Mladen Valkov in paper and electronic media is in accordance with the Regulations for the Implementation of the Law on the

Development of the Academic Staff in the Republic of Bulgaria and includes the following documents:

1. Application to the Director of IMI-BAN for admission to defense;
2. Professional resume;
3. Order for enrollment in doctoral studies;
4. Protocols for passed exams;
5. Order for dismissal from doctoral studies;
6. Order of the Director of IMI for discussion of the dissertation work in the primary unit;
7. Minutes of discussion of the dissertation work in the primary unit;
8. List of dissertation publications;
9. List of citations of the publications on the dissertation;
10. copies of the publications on the topic of the dissertation work;
11. Dissertation work;
12. Reference for the contributions in the dissertation and publications;
13. Abstract.

The dissertation "Development of digital competence in mathematics education" consists of an introduction, three chapters, a conclusion, a list of references, contributions of the dissertation and a list of author's publications on the topic. The content is developed in a volume of 202 pages of main text, no appendices are presented. The used literature contains 91 titles, of which 38 are in Bulgarian and 53 in English.

2. Brief biographical data for the doctoral student

Mladen Georgiev Valkov earned a bachelor's degree in computer science and a master's degree in applied mathematics - Optimization at the Faculty of Mathematics and Informatics of the University of St. Kliment Ohridski".

From 2018 until now, Mladen Valkov has worked as a software engineer in two companies.

From 2015 to 2018 worked as a mathematician at the Institute for Progressive Education and as a teacher at Sofia University - Faculty of Mathematics and Informatics.

Has computer skills for Programming (C++), Wolfram mathematica, Adobe indesign. In his CV, he also mentions problem-solving skills, teamwork, creativity, self-motivation, planning, etc. The autobiography also mentions numerous awards from international and national mathematical competitions in which Valkov participated as a student and pupil.

The mentioned activities are a bet for expertise in the field of mathematics and computer science.

3. Actuality of the topic and appropriateness of the set goals and tasks

The formation of digital competences in the conditions of digital transformation is definitely an actual and significant problem for the modern development of society in general and education in particular. The development of ICT and the need to create and share good practices in support of mathematics education is the basis of the dissertation research. The goal is to develop a toolkit for the development of students' digital competence in their mathematics education. All this makes the presented dissertation research extremely relevant for modern pedagogical theory and especially for practice. These premises are correctly and clearly justified in the dissertation research, which very well introduces the essence of the research.

4. Essence of the dissertation work and research methodology

In the first chapter of the dissertation research, an analysis of international, European and national strategic documents related to digital competence is made. The main concepts of the subject of the study are defined in accordance with European and national normative documents. Examples of the development of digital competence in mathematics education are presented, in which the emphasis is on: specialized software for mathematics education, synchronous distance learning platforms, games as a means of teaching mathematics, video learning, competitive mathematics and digital competence, augmented reality and virtual

reality in mathematics education, learning the features of a digital tool, multidisciplinary lessons and digital competence.

In the second chapter, the StruniMa training system is presented, proposed as a tool for the development of digital competence in mathematics education. In it, in the form of a network video game, aimed at learning topics such as "Board Symmetry", "Board Covers", "Graphs and Chains", "Knots and Connections" and more. The StruniMa training system is made using the Unity3D game engine and enables the generation of many specific games, while simultaneously providing the opportunity for online communication, monitoring, training, feedback, evaluation, etc.

In the third chapter, a pedagogical experiment is presented, through which the aim is to establish the possibility of providing conditions for the development of digital competence of students when using StruniMa. The possibilities for developing the digital competence of students in propaedeutics, introduction, study, application, updating of types of symmetries, for students from 1 to 9 grades are checked.

The possibilities for the development of digital competence were observed in terms of information literacy and literacy for data and content processing, in Communication and cooperation and participation in society, in Creating digital tools and ethical principles, in Safety and Security, and in Dis- problem solving.

Through the conducted pedagogical experiment, the capabilities of the developed toolkit for the development of students' digital competence through mathematics education have been proven.

5. Contributions and significance of the development for science and practice

The main contributions of the dissertation work can be summarized in a scientific-applied aspect as follows:

- On the basis of an in-depth analysis of international, European and national strategic documents, scientific research and educational literature, a specification has been made regarding school mathematics education. Approaches, methods, technologies and means related to the development of digital competence in mathematics education are analyzed, such as research approach, project-based approach, AR, VR, video training, online competitions, specialized software for creating computer models of mathematical objects, etc.
- The StruniMa training system has been developed in the form of a networked video game, through which multiple concrete games can be generated, to provide online communication, monitoring, training, feedback and evaluation.
- Generated and made freely available are specific PC, augmented reality and virtual reality games.

- Methodological guidelines for using the training system have been developed. Opportunities are presented to use the functionalities of "StruniMa" in learning about some topics such as "Symmetry on a board", "Covers on a board", "Graphs and chains", "Knots and connections".

- A toolkit was developed for conducting a pedagogical experiment, which proved the possibility of providing conditions for the development of digital competence in school mathematics education using the "StruniMa" training system.

6. Evaluation of publications on the dissertation work

In the attached materials, the doctoral student has attached a list of four publications related to the dissertation research. One of the publications is independent, three are co-authored. One of the publications is in English, three are in Bulgarian.

The submitted publications meet the requirements in terms of number and content. They have been published in refereed and peer-reviewed journals. They reflect the doctoral student's experience in the field of dissertation research and the overall activity of the doctoral student.

7. Abstract

The abstract was developed according to the requirements of the Rules for the Development of the Academic Staff and accurately reflects the main results achieved in the dissertation research.

8. Critical remarks and recommendations

I have no critical remarks about the presented materials and the dissertation research as a whole. Question: What do you think are the prospects for the development of dissertation research? How would you proceed?

9. CONCLUSION

The dissertation contains scientific, scientific-applied and applied results, which represent an original contribution to science and meet all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB) and the Regulations for the Implementation of ZRASRB.

The dissertation shows that the doctoral student Mladen Georgiev Valkov possesses in-depth theoretical knowledge and professional skills in the scientific specialty "Methodology of teaching in mathematics, informatics and information technologies", demonstrating very good qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my positive assessment of the conducted research, presented by the above-reviewed dissertation work, auto-abstract, achieved results and contributions, and I propose to the honorable scientific jury to award the educational and scientific degree "doctor" to Mladen Georgiev Valkov in professional direction 1.3 Pedagogy of training..., Doctoral program: "Methodology of training in mathematics, informatics and information technologies".

24.04. 2024

Retsenzent:

Prof. Galya KozhukharovaPhD