OPINION

by Assoc. Prof. Dr. Elena Karashtranova

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of a dissertation on:

DEVELOPING DIGITAL COMPETENCE IN MATHEMATICS EDUCATION

for awarding the educational and scientific degree "doctor",

in the field of higher education 1. Pedagogical sciences,

professional direction 1.3. Pedagogy of training in...,

doctoral program Methodology of Education in Mathematics, Informatics, and Information Technologies

Author of the dissertation: Mladen Georgiev Valkov

This opinion was prepared on the basis of order No. 53/27.02.2024 of the Director of the Institute of Mathematics and Informatics at the BAS and in accordance with the Law on the Development of the Academic Staff in the Republic of Bulgaria, the Rules for its Implementation and the Rules of the Institute of Mathematics and Informatics of the BAS for acquiring scientific degrees and occupying academic positions.

1. Brief biographical data

From the provided autobiography it is clear that Mladen Georgiev Valkov completed his secondary education in Shumen. In 2011, he entered the FMI of SU "St. Kliment Ohridski", where he received a bachelor's degree in informatics in 2015 and a master's degree in applied mathematics in 2017. As a pupil and student, he participated in a number of national and international competitions and Olympiads, where he received high honors.

2. Relevance of the problem

Undoubtedly, digital competence and the digital transformation of education are priorities at the modern stage of society's development. There are opportunities in mathematics education and it is appropriate to use them to develop digital competences. This determines the relevance of the dissertation research, which is dedicated to the possibilities of applying the educational system ***StruniMa*** developed by the doctoral student as a tool for the development of digital competence in mathematics education using augmented reality, virtual reality and educational games.

3. Brief description of the dissertation work

The set of materials presented by the candidate under the present procedure includes a dissertation, an abstract, a curriculum vitae and four publications on the topic of the dissertation research. The dissertation on "Developing Digital Competence in Mathematics Education" consists of 215 pages and is structured into an introduction, three chapters, a conclusion, contributions and references.

The dissertation is well-formed and meets the requirements.

The proposed project for the abstract presents the main content of the dissertation work and gives a clear idea of the work done by the PhD student.

In the introduction of the dissertation work, the goal of the research, the object of research, the subject of research, the research tasks and the hypothesis of the research are correctly defined.

In the first chapter, an in-depth analysis of international, European and national strategic documents, scientific literature and educational documentation related to digital competence is made. Possibilities and examples of developing digital competence in mathematics education are also discussed. The need to develop educational resources for teaching mathematics with augmented reality and virtual reality, educational games and video materials is justified.

In the second chapter there is a description of the ***StruniMa*** training system developed by the doctoral student as a tool for developing digital competence in mathematics education. The principles for development and the possibilities it offers for teaching mathematics are presented. Sufficiently complete instructions have been made for the use of the developed system at various levels and formats. Examples, problems, and games from fun and competitive math and graph theory are included.

In the third chapter, the organization and methodology of the pedagogical research is described and the results of the conducted experiment are correctly analyzed. The content analysis of the results makes a good impression.

4. Overview of the cited literature

The total number of indicated sources is 91, of which 38 are in Cyrillic and 83 are in Latin. Articles from anthologies and magazines, books, normative documents, etc. related to the topic of the study are included in sufficient volume and quality. The PhD student demonstrates in-depth knowledge of the subject under consideration and skills in the analysis of normative documents and specialized literature.

5. Main Contributions

I accept the presented contributions of the dissertation work:

• An analysis of international, European and national strategic documents, scientific studies and educational literature related to the digital transformation of education was made. On the basis of several models of digital competence - of citizens, of users, in education a specification has been

made that refers to 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 learning, competitions requiring the use of digital tools or technologies, specialized software for creating computer models of mathematical objects, etc.

• The "***StruniMa***" training system was developed in the form of a network video game. Through it, multiple concrete games can be generated, online communication, monitoring, training, feedback and evaluation can be provided. Several specific games have been generated and made freely available for PC, augmented reality, and virtual reality, respectively. 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", "Board covers", "Graphs and chains", "Knots and connections". A holistic approach to teaching and learning has been developed and its impact on groups of learners working with learning content with AR has been explored.

• A toolkit for conducting a pedagogical experiment, which proves the possibility of providing conditions for the development of digital competence in school mathematics education using the ***StruniMa*** educational system, has been developed.

6. Publications on the topic of the dissertation

Four publications are presented on the subject of the dissertation, three of which are co-authored and one is a standalone article. They are related to the dissertation research, reflect its main results and fully satisfy the requirements for obtaining the educational and scientific degree "doctor".

7. Critical notes and recommendations on the dissertation

As an idea for future research, in my opinion, the developed system could also be incorporated into the education of mathematics university students and future mathematics teachers.

8. Conclusion

The dissertation contains scientific-applied and applied results that represent an original contribution to science and meet the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for the Implementation of LDASRB and the Rules of the Institute of Mathematics and Informatics of the BAS for acquiring scientific degrees and occupying academic positions.

The dissertation shows that the PhD student Mladen GeorgievValkov possesses theoretical knowledge and professional skills in the scientific specialty "Methodology of Education in Mathematics, Informatics, and Information Technologies", demonstrating 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, abstract, achieved results and contributions, and I

propose to the Honored Scientific Jury to award the educational and scientific degree "doctor" to Mladen Georgiev Valkov in the field of higher education 1. Pedagogical sciences, professional direction 1.3 Pedagogy of training in..., doctoral program: "Methodology of Education in Mathematics, Informatics, and Information Technologies".

28/04/2024

Reviewer:

/E. Karashtranova/