

OPINION

on the dissertation for the acquisition of the educational and scientific degree
"Doctor"

Author of the dissertation: MSc Maya Stefanova Staikova

Topic of the dissertation: Information and communication technologies in STEM
education

Member of the scientific jury: Prof. Dr. Eng. Kosta Boshnakov, appointed as a
member of the scientific jury by order 345/29.12.2025 of the Director of ICT-
BAS

1.Relevance of the problem developed in the dissertation in scientific and scientifically applied terms.

The problem developed in the dissertation is relevant and socially significant in
relation to STEM education, the digital transformation of education and AI
literacy.

2.Degree of knowledge of the state of the problem and creative interpretation of the literary material.

A bibliography with 124 current literary sources is attached to the dissertation.
The first two chapters provide a review of the literature on some of the problems
related to the dissertation, namely: ranking of the countries of the Organization
for Economic Cooperation and Development by the indicator of graduates of
STEM education; a comparison was made between the career opportunities and
income of students with STEM degrees and those with non-STEM degrees; the
development of STEM education in Bulgaria after the adoption of the Strategy
for the Effective Implementation of Information and Communication
Technologies (ICT) in Education and Science was examined; The application of
ICT, integrative technologies and specifically robotics and artificial intelligence is
examined and the effectiveness of edge and cloud computing is compared.
References to literary sources continue throughout the dissertation.

Based on the first two chapters, it can be concluded that MSc M. Staikova has in-
depth knowledge of the problems related to the state of STEM education in the
world and the country

3.Compliance of the chosen research methodology and the set goal and tasks of the dissertation with the achieved contributions.

The following goal of the dissertation is formulated. To show how information
and communication technologies are applied in STEM education and specifically
how robots can help in technological education, including information

technology, mechanics, physics, engineering, mathematics, etc. To achieve the goal, 5 tasks have been set.

The hypothesis has been raised that ICT is a useful tool for use in education and unifying different subjects in STEM education.

In order to create lessons for STEM education, the following mini robots were presented in detail, software was created, capabilities were tested, and experiments were conducted with students with the following mini robots: Ozobot Evo, BlueBot, ArtieMax, Artie 3000, Cody Rocky, XGO-mini 2 Dog, intelligent robots, Tele-ROBCO, etc.

4. Scientific-applied and applied contributions of the dissertation work

The dissertation work contains the following more important scientific-applied and applied contributions:

1. The capabilities of individual robots are analyzed from the point of view of application in STEM education for different age groups of students.
2. Algorithms have been developed for the Ozobot EVO and XGO mini 2 Dog robots for movement according to set tasks and requirements,
3. Algorithms have been developed for the ArtieMax robot for an integrated STEM lesson and for writing a specific word.
4. An algorithm has been developed for the Codey Rockey chain robot for movement that avoids obstacles and for the Artie 3000 robot - for drawing various graphic models.
5. Based on the technical capabilities of the robots under consideration, STEM lessons are presented, which have been tested in a real environment with students between 6 and 18 years old and teachers.
6. A comprehensive cartography lesson has been developed, which allows for the inclusion and acquisition of knowledge in mathematics, computer science, robotics, electrical engineering, etc.

5. Evaluation of publications in the dissertation work

The list of publications to the dissertation work includes 9 scientific papers, thematically focused on STEM education, educational robotics, artificial intelligence and machine learning. A significant part of them have been published in prestigious publications such as MDPI, IEEE Xplore, IFAC PapersOnLine, etc. Eight of the attached publications are indexed in world-renowned databases with scientific information and one is in a non-refereed journal with scientific review. The publications are co-authored by the doctoral student, her scientific supervisor and colleagues. In 5 of them, MSc M. Staikova is the first author. A list of 5 citations is attached.

6. Opinions, recommendations and notes.

- The dissertation contains a large amount of explanatory text that would be much more suitable for a textbook.
- Two citations of scientific works are presented in the dissertation, but it is not indicated which scientific works the citations refer to.

7. Conclusion with a clear positive or negative assessment of the dissertation work

My overall assessment of the dissertation work of MSc Maya Stefanova Staikova is positive.

The analysis of the fulfillment of the minimum national requirements for acquiring the educational and scientific degree "doctor" in the professional field 5.2 Electrical Engineering, Electronics and Automation and the requirements of the Regulations on the specific conditions for acquiring scientific degrees and for occupying academic positions at the Institute of Information and Communication Technologies shows that according to the group of indicators A, with the required 50 points, with the presented dissertation work MSc M. Staikova achieves these points also in the group of indicators G, with 30 points required, MSc M. Staikova has achieved 151.2 points, with eight of the applied scientific publications in the group of indicators G being in editions that are referenced and indexed in world-renowned databases of scientific information (G7).

Based on my positive assessment of the dissertation work and the information presented in this opinion, I propose to the esteemed Scientific Jury to award **MSc Maya Stefanova Staikova the educational and scientific degree "Doctor"**, in the scientific field 5. Technical Sciences, professional field 5.2 Electrical Engineering, Electronics and Automation, scientific specialty "Application of the Principles and Methods of Cybernetics in Various Fields of Science".

Дата: 23.02.2026

ЧЛЕНЪ

НА ОСНОВАНИЕ
ЗЗЛА