

OPINION

by: Prof. Nikolay Ivanov Stoimenov, Ph.D.,
Institute of Information and Communication Technologies,
Bulgarian Academy of Sciences,
external member of the scientific jury by Order No. 94/29.07.2026 of the Director of IR-BAS

*on a dissertation for obtaining the
educational and scientific degree "Doctor (Ph.D.)"*

Author of the dissertation thesis: mas. eng. Borislava Lyubomirova Kostova

Thesis of the dissertation: "Integration of 3D Printing and Robotics with Modern Technologies for Educational Purposes"

Field of higher education: 5. Technical Sciences

Professional field: 5.2. Electrical Engineering, Electronics and Automation

Doctoral programme: "Application of the Principles and Methods of Cybernetics in Various Fields of Science"

Scientific supervisors: Prof. Ivan Chavdarov, Ph.D., and Assoc. Prof. Galya Georgieva-Tsaneva, D.Sc.

General characteristics of the dissertation

The dissertation has a volume of 150 pages and is structured into an introduction, five chapters, a conclusion, prospects for future research, a list of contributions, approbation of the results, publications, recorded citations, appendices and a bibliography. It contains 44 figures and 13 tables. A total of 140 literature sources are cited, predominantly foreign sources.

The doctoral candidate was enrolled in part-time doctoral studies in the "Robotized and Mechatronic Intelligent Systems" department of IR-BAS by Order No. 86/23.06.2023 and was discharged with the right to defend by Order No. 88/16.07.2026.

1. Relevance and significance of the problem addressed

The dissertation addresses a topical and socially significant area — the integration of 3D modelling, 3D printing, robotics and artificial intelligence into the educational process. The STEAM model is established as a leading pedagogical framework, but its practical implementation meets real barriers: limited preparation time, dependence on the teacher's individual technological qualification, and the lack of accessible software solutions for automated 3D modelling.

The second line of the research is particularly significant — personalised assistive aids for pupils with special educational needs. Writing aids available on the market are expensive and poorly adaptable, while existing software solutions rely on 3D scanning, which impedes subsequent iterations. The search for a low-cost and reproducible alternative through 3D printing is a task with a direct social effect.

2. Degree of familiarity with the state of the problem and assessment of the publications

The literature review in Chapter 1 covers 140 sources and is structured according to the three educational directions under consideration — general education, education specialised in creative disciplines, and education directed at pupils with special educational needs. For each of them, the applications of 3D printing, educational robotics and artificial intelligence are examined separately, with the advantages as well as the limitations of each technology consistently indicated.

The review concludes with a separate section on the gaps and limitations in existing research, from which the aim and the five tasks of the dissertation follow. The candidate is familiar in detail with the state of the field under consideration and possesses the capacity required to obtain new results.

The results have been published in four scientific articles presented at international conferences in Bulgaria and abroad. One of them appears in a publication with an SJR rank (Q3), two are indexed in Scopus and Web of Science, and one has an ISSN. Five citations have been recorded. The results have also been reported at four international scientific forums.

The publications reflect, present and disseminate the main parts of the dissertation. It may be concluded that the results have become known and accessible to the scientific community.

3. Assessment of the scientific results and the contributions

I accept the contributions formulated by the author, which are of a scientific-applied and applied nature, and assess them positively. Some of the applied contributions would benefit from being formulated in terms of the result achieved.

The two scientific-applied contributions consist in the development of a protocol for conducting an educational STEAM activity, combining AI-assisted planning, 3D printed educational models and scenarios for the humanoid robot NAO, as well as in the approach for the automated creation of 3D printed personalised models, in which the algorithm searches for optimal parameters in three directions — adaptation to the user, adaptation to the instrument, and visual educational effect.

The applied contributions comprise two working software implementations in the AutoCAD environment. The program “rings” is intended for specialised artistic education and has two modes — automated and educational, in which execution is interrupted step by step in order to show the pupil how the model is built. The program “pinky” automates the creation of a personalised writing aid device by parameterising the diameter of the sphere, the radii and depth of the axial constraints, and the angles of their rotation.

It is worth noting that both programs have been tested in a real environment and not only in the laboratory. The relationship between the geometric complexity of the models, the printing time, the quality and the strength has been investigated separately, which gives the applied part engineering value beyond the software implementation.

4. Critical remarks and recommendations

The dissertation is well structured, developed in detail, and is distinguished by thoroughness and a consistent effort to arrive at a workable solution. The area under investigation offers potential for further development. My remarks are constructive and do not call the results obtained into question.

The number of participants in the experiments conducted is limited, and in the study of the writing aid device the pilot trial involved one participant. The author correctly indicates this limitation and does not overstate the results obtained, which I regard as a mark of research integrity. As a

recommendation for future research activity, I suggest that the developed protocol and approach be validated on a larger and more balanced sample, across several school subjects and over a longer period.

I also recommend that the candidate increase her publication activity in scientific journals with an impact factor and/or SJR rank.

The dissertation contains spelling and technical inaccuracies — an incomplete listing of the appendices in the table of contents, an incorrect internal reference in Chapter 2, and a technical error in the designation of the 3D printing technology. I have shared these inaccuracies with the doctoral candidate. The inaccuracies do not diminish the value of the dissertation.

5. Conclusion

The dissertation contains scientific-applied and applied results that constitute an original contribution to science, and demonstrates that the candidate possesses in-depth theoretical knowledge in the respective specialty and the ability to conduct independent scientific research. The requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria, of the Regulations for its implementation, and of the Regulations on the conditions and procedure for obtaining scientific degrees and holding academic positions at the Bulgarian Academy of Sciences have been met. The stated aim has been achieved.

6. Assessment

On the basis of my acquaintance with the dissertation and the materials relating to it, the fulfilled educational objective of the doctoral studies, the relevance of the subject and the significance of the scientific-applied and applied contributions achieved, I confidently give a positive assessment of the dissertation work of mas. eng. Borislava Lyubomirova Kostova.

I propose to the honourable Scientific Jury to award mas. eng. Borislava Lyubomirova Kostova the educational and scientific degree “Doctor (Ph.D.)” in the field of higher education 5. Technical Sciences, professional field 5.2. Electrical Engineering, Electronics and Automation, doctoral programme “Application of the Principles and Methods of Cybernetics in Various Fields of Science”.

Sofia, 11.09.2026

MEMBER OF THE JURY: ...

(Prof. Nikolay Stoimenov, Ph.D.)