

REVIEW

by **Assoc. Prof. Daniela Todorova Kozhuharova, PhD**
Faculty of Education, Trakia University – Stara Zagora

on dissertation for the award of the educational and scientific degree "**PhD**"

By: field of higher education *1. Pedagogical Sciences*

Professional field *1.3. Pedagogy of education in ...*

PhD Programme *Methodology of Information Technology Education*

Author: *Vera Petkova Shopova*

Subject: *Use of Information Technologies for the Implementation of Cross-Curricular Connections in Science Education in Junior High School*

Supervisor: *Prof. Kosta Atanasov Garov, PhD – Plovdiv University "Paisii Hilendarski"*

1. General description of the submitted materials

By Order № RD-21-2451 of 15.12.2023 of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury for the procedure for the defense of my dissertation thesis on "**The use of information technologies for the implementation of inter-subject links in the teaching of natural sciences in junior high school**" for the acquisition of the educational and scientific degree " PhD" in the field of higher education 1. Educational Sciences, professional field 1.3. Pedagogy of Education in ..., PhD programme Methodology of Information Technology Education. The author of the dissertation is Vera Petkova Shopova - a PhD student in full-time study at the Department of Mathematics, Informatics and Information Technologies Education with a scientific supervisor Prof. Dr. Kosta Atanasov Garov from Paisii Hilendarskiy University. At the first meeting of the scientific jury I was selected as a reviewer of the dissertation according to the protocol №1/19.12.2023.

The set of materials submitted by Vera Petkova Shopova on electronic media is in accordance with Article 36 (1) of the Regulations for the Development of the Academic Staff of PU, includes the following documents:

1. Application to the Rector of PU for the disclosure of the procedure for dissertation defence;
2. CV in European format;

3. Protocol No. 1-2023/2024 dated 11.12.2023 of the Departmental Council, related to the reporting of the readiness for the opening of the procedure and the preliminary discussion of the dissertation;
 - 3.1. Opinion of the supervisor on the readiness of the PhD student for discussion of the dissertation at the departmental council;
4. Abstract:
 - 4.1. in Bulgarian;
 - 4.2. in English;
5. Declaration of originality and authenticity of the attached documents;
6. Reference for compliance with the National Minimum Requirements for the Acquisition of the PhD Degree of Education and Science;
7. List of scientific publications on the topic of the dissertation;
8. Dissertation;
9. Copies of scientific publications on the topic of the dissertation;

The PhD student has attached six publications on the topic of the dissertation.

The submitted documents are precisely formatted and arranged in accordance with the attached list.

2. Brief biographical data about the PhD student

Vera Petkova Shopova graduated in 2000 from Paisii Hilendarski University with a Master's degree and acquired the qualification of a teacher of biology and chemistry. From 2011 to 2012 she continued her studies at PU in the master's program "Information and Information Technologies in Primary School". She acquired her V and IV professional qualification degrees at the Department for Information and Teacher Qualification at Trakai University - Stara Zagora in 2016 and 2018, respectively.

From 2020 to 2023, she will be teaching at the School of Education and Science. Vera Shopova is a full-time PhD student at the Department of Mathematics, Informatics and Information Technology Education, PhD program "Methodology of Information Technology Education" of the Faculty of Mathematics and Informatics of PU.

Vera Shopova's work experience began as a teacher in the junior secondary stage from 2002 to 2011 at the "Pencho Slaveykov" Primary School, village of Belashchitsa, municipality Rodori. She

graduated from the school in Sofia in the summer of 2007. From 2011 to 2023 she was a senior teacher in the junior secondary stage at the "Dimitar Talev" Primary School, Sofia. She is a teacher at the school of Dimitar Talev, Plovdiv. From 2023 to the present she has been working as a senior teacher in the junior secondary stage at the "Knyaz Aleksandar I" Primary School, Plovdiv. She is also a graduate of the Plovdiv school.

Vera Shopova is a mentor in IT of students under the project "Student Practices", she is a leader of a group of students under the projects "Your Lesson" and "Success". In the period 2021 - 2023 she is certified as a Google-trainer level 1 and level 2. She has been the administrator of the cloud technology and the electronic diary in the primary school "Dimitar Talev".

PhD student Vera Shopov possesses organizational skills and competencies acquired from her work as chairperson of the SBU at the KNSB, chairperson of various committees and unions, mentor of students, head of science clubs and class teacher. She is involved in the development and implementation of educational projects at national and school level.

3. Relevance of the topic and appropriateness of the aims and objectives

The dynamic development of information technologies and their implementation in the educational process allows them to be used as didactic tools for effective acquisition of the necessary knowledge, skills and competences in the training of various disciplines. Along with supporting the learning process, their use leads to the development of digital competence of students and supports the development of their functional literacy by providing tools for easier understanding, comprehension and application of the learning material.

Through the study of the subjects Computer Modelling, Computer Modelling and Information Technology and Information Technology in the period 3-12 grade, students acquire the knowledge and skills to work with specific information technologies and competencies to use them in problem solving. This makes the disciplines suitable for cross-curricular links with all school subjects, including science.

Another aspect of the relevance of the problem is the active introduction of the STEM approach in Bulgarian education in recent years. Some of the schools in Bulgaria already have equipped STEM centres and many others are in the process of implementing projects for their development. As part of STEM, the integration of science and IT education offers a contemporary trend on which the author's model presented in the thesis is built.

4. Knowing of the problem

In the dissertation submitted for review, the PhD student demonstrates her knowledge in the field of the subject under consideration, presenting her vision of the existing problems and their solution. Vera Shopova makes a theoretical analysis of the scientific literature on issues related to information technology in the process of teaching and learning, through the realization of inter-subject links between information technology and natural sciences. The analyses of the scientific literature combined with the proposed author's model of an innovative educational methodology based on the use of inter-subject links in teaching science and information technology are evidence of the knowledge of the state of the research problem at the theoretical, methodological and applied level.

5. Methodology of the study

In order to achieve the aims and objectives of the dissertation research and to verify the hypothesis, a variety of effective research methods were used: research and analysis of pedagogical, methodological and educational literature related to the problems of the study; theoretical and empirical research methods: observation, comparison, analysis, synthesis, modeling, theoretical generalizations, group discussions, discussions with current science teachers. The PhD student also used her personal experience in the field of science education with the application of IT to implement cross-curricular links in primary school. A didactic experiment was made and mathematical-statistical methods were applied to process the experimental data. The chosen research method is appropriate and allows to solve the set tasks and to achieve the set goals.

6. Characteristics and evaluation of the thesis

The dissertation "The use of information technologies for the realization of inter-subject links in the teaching of science in junior high school" consists of an introduction, three chapters, a conclusion, perspectives for future development, main contributions of the dissertation, a list of author's publications on the topic and papers presented, a list of citations, a list of participation in research projects, acknowledgements, references used, appendices. The content is developed in 136 pages of main text and 3 annexes. The literature used contains 101 references, of which 63 are in Cyrillic and 38 in English, and 133 Internet references.

In the introduction, the PhD student has motivated the choice of the topic. She presented the aim, objectives, subject and object of the research, as well as hypothesis and methods of the research. It is not clear from the formulations presented in the concept whether information technologies for the implementation of cross-curricular connections in science education are being investigated or

whether the cross-curricular connections being investigated will be between science and information technologies.

Chapter 1 provides an overview of the current set of curricular and normative documentation related to the teaching of IT at the lower secondary level and discusses the possibilities for integrating current ICT into science classes for successful cross-curricular connections. Opportunities for the use of IT in the learning process are presented and possibilities for integrating current ICT in science teaching are explored. The nature of the concept of "intersubject links" is clarified from a historical and pedagogical perspective. The benefits of the application of IT in the science teaching process are outlined. From the made exposition it is not clear what are the possibilities of realization of intersubject connections between natural sciences and IT. There is an inaccuracy in the presented analysis of the computer modelling curriculum: algorithms with conditions are taught in grade 4, not grade 3 (p. 16).

In Chapter 2 an author's interdisciplinary methodological model for science education with application of IT in lower secondary education is described and presented schematically. The aims, objectives and expected results of each stage of the proposed interdisciplinary model are developed and explained, and approaches and methods for their implementation in classes and extracurricular activities in the lower secondary stage of primary education are proposed. Specific information technologies are proposed for the implementation of the different stages of the model. A link is made between the STEM-approach and learning, through cross-curricular links between science and information technologies. It describes the validation of the model in seven learning projects conducted in the 2020/2021, 2021/2022 and 2022/2023 school years.

Chapter 3 describes the dissertation research methodology. The instrument used to measure the results of the study and the contingent - 300 students from 5th, 6th and 7th grades from the "Dimitar Talev" Primary School in Plovdiv - are described and justified. The criteria and indicators for evaluation of the acquired knowledge and skills of the students from the preliminary and formative pedagogical experiment are described. The analysis of the collected data from the pedagogical research is made. A detailed description of the preliminary (preparatory) pedagogical experiment and the conduct of the formative pedagogical experiment is missing.

No conclusions are drawn from the dissertation research.

The perspectives for future development and continuation of the described experiment are outlined, by creating a system of lessons in different disciplines based on the author's model, publishing them in the "Digital Backpack", conducting teacher trainings and developing a methodological guide for teachers in order to prepare them for the application of the interdisciplinary methodo-

logical model, creating STEM lessons based on the model and extending the model by using the capabilities of artificial intelligence.

The Appendix presents the tests used in the pre- and formative experiments.

The dissertation research is not well balanced. The length of chapter two is approximately equal to the length of the introduction, chapters one and three, and the conclusion combined. The recommendation is that the three chapters in the thesis should be of approximately equal length. Chapter two, in addition to the author's model, contains a theoretical justification to the individual components of the model, which should be described in chapter one. This, together with a detailed description of the experiments, would lead to a better balance in the thesis.

7. Contributions and Significance of the Development for Science and Practice

The main contributions of the dissertation research are in scientific and applied aspects and can be formulated as follows:

- 1) An author's interdisciplinary methodological model for the realization of the intersubjective links between natural sciences and IT in the educational process is developed.
- 2) Didactic methods and means for successful implementation of the proposed interdisciplinary model are proposed.
- 3) Author's projects are developed using the interdisciplinary methodical model, which can be directly applied in pedagogical practice.
- 4) A pedagogical experiment has been carried out to establish the effectiveness of the interdisciplinary methodological model.

The relationships between the contributions, the tasks, the place of description in the dissertation and the publications made are described in Table.

I consider that the mentioned contributions are significant and sufficient for awarding the degree of PhD of Education and Science.

8. Assessment of publications on the thesis

On the topic of the dissertation 6 publications have been presented, 5 of them are co-authored and published in peer-reviewed journals and 1 independent, published in a conference proceedings. The ideas presented in them correspond to the topic of the dissertation. The presented model and some of the shared good practices have been published and are available to the general public.

9. Personal participation of the PhD student

The professional qualification and experience of Vera Shopova, as well as the presented publications on the topic of the dissertation research, give me reason to believe that the PhD student personally conducted the dissertation research and the formulated contributions and better results are her personal merit.

10. Abstract

The abstract is 32 pages long and sufficiently reflects the essence of the dissertation, the conducted research and the achieved results. It is provided in Bulgarian and English.

11. Critical comments and recommendations

- It is noteworthy that in some places the author writes in the third person;
- The citations in the main text and the description of the literature are disparate;
- Literature source cited that is not described in the literature is noted - (Cohen, L., 2005) on p. 44.
- There are inaccuracies in the use of scientific terminology in places.

12. Personal impressions

I do not know the PhD student personally and have no impressions of her work.

13. Recommendations for future use of the dissertation contributions and results

I recommend that when the dissertation research is published in a monograph, the title be reworded. Thus set, the title implies that the inter-subject connections will be between the different natural sciences and will be realized with the help of information technology. But in fact the inter-subject links for which the research was done were between information technology and the natural sciences. Also to refine the statement in the main text of the study along the same lines.

14. Questions to the PhD student

- On p. 112 it says that the preliminary (ascertainment) experiment defined the "criteria and indicators of the study". What are they?
- Describe the formative experiment in the science classroom revealing the role of cross-curricular connections in the effective learning of course material. In the description, identify the specific units from the IT and science textbooks between which the cross-curricular connections are made.

- What main conclusions could you draw from the study?

CONCLUSION

In spite of the findings and remarks made, I believe that the dissertation *contains scientific and applied results that represent an original contribution to science* and sufficiently meet the requirements of the Law for the Development of Academic Staff in the Republic of Bulgaria (LADAB), the Regulations for the Implementation of the LADAB and the relevant Regulations of Paisii Hilendarski University.

The dissertation work shows that the PhD student Vera Petkova Shopov possesses theoretical knowledge and professional skills in the methodology of information technology education, demonstrating qualities and skills for independent scientific research.

Because of the above, I give my **positive evaluation** for the conducted research, presented by the above reviewed dissertation, abstract, achieved results and contributions, and I propose the honorable scientific jury to award the educational and scientific degree "PhD" to Vera Petkova Shopova in the field of higher education. 1.3. Educational Pedagogy in the PhD programme Methodology of Information Technology Education, **after answering the questions posed in the review.**

26.01.2024

Reviewer:

Assoc. Prof. Daniela Kozhuharova, PhD