

REVIEW

by **Dr. Zhelyazka Dimitrov Raykova,**

professor at Paisii Hilendarski University of Plovdiv

of a dissertation for awarding the educational and scientific degree "doctor"

by: field of higher education 5. Technical sciences

professional direction 5.3 Communication and computer technology

doctoral program "Automation of fields from the intangible sphere (medicine, education, science, administrative activity, etc.)"

Author: *Tsvetelina Lachezarova Ivanova-Varadinova*

Topic: **A system of technology-based decisions in engineering education**

Research supervisor: Assoc. Dr. Nadezhda Miteva Kafadarova, PU "Paisii Hilendarski".

1. General description of the presented materials

By order No. P21-719 of 04/02/2024. of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury to ensure a procedure for the defence of a dissertation work on the topic "System of technology-based decisions in engineering education" for the acquisition of the educational and scientific degree "doctor " in the field of higher education 5. Technical sciences, professional direction 5.3 Communication and computer technology, doctoral program Automation of areas from the intangible sphere (medicine, education, science, administrative activity, etc.). The author of the dissertation is Tsvetelina Lachezarova Ivanova-Varadinova - a full-time doctoral student at the Department of Electronics, Communications and Information Technologies, with a supervisor, Assoc. Dr. Nadezhda Miteva Kafadarova from Plovdiv University "Paisii Hilendarski".

The set of materials presented by Tsvetelina Ivanova-Varadinova is in electronic format and is in accordance with Article 36 (1) of the Rules for the Development of the Academic Staff of the PU, includes the following documents:

- A request to the Rector of the PU to disclose the procedure for the defence of a dissertation work;
 - CV in European format;
 - Protocol from the departmental council related to reporting the readiness to open the procedure and preliminary discussion of the dissertation work;
 - Dissertation work;
 - Abstract;
 - A list of scientific publications on the topic of the dissertation;
 - Copies of scientific publications. The doctoral student has attached 8 (eight) publications.
 - Declaration of originality and authenticity of the attached documents.
- I have no objections to the documents provided to me.

2. Brief biographical data for the doctoral student

Tsvetelina Ivanova-Varadinova was born on 02.11.1993. and completed his secondary education at the "St. St. Cyril and Methodius" in the city of Plovdiv in 2012. In 2016 graduated as a bachelor with a major in "Information Physics and Communications" at Plovdiv University. In 2019, he successfully graduated from the OKS Master "Physics Teacher" at the same university. In the period of 2016 - 2017 worked successively as a "computer operator" at Stib Control EOOD and later at PU as an "organizational service" expert. From 2020 until now, he is an assistant in the "Educational Technologies" department at the Faculty of Physics and Technology of Plovdiv University "Paisii Hilendarski".

In March 2020 was enrolled as a full-time doctoral student in the Department of Electronics, Communications and Information Technologies (ECIT) of the University of Plovdiv "Paisii Hilendarski" with supervisor Prof. Dr. Nadezhda Kafadarova and in March 2023. is charged with the right of defence.

Tsvetelina Ivanova-Varadinova has fulfilled all the requirements under the Law for the Development of Scientific Personnel and the rules of the PU "PPaisii Hilendarski" under the procedure for the acquisition of academic degree "Doctor".

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

The problem of the digital transformation of the organization of learning models motivates a number of pedagogical innovations. This process emerged with great force following the COVID-19 pandemic. Despite numerous scientific studies in education, there is a lack of a focused study of this problem in the field of engineering education, which determines the relevance and importance of the dissertation topic. In this sense, the presented experimental study has its scientific-applicable value for the methodology of engineering education.

The doctoral student shows a good understanding of the innovative by choosing for scientific research an educational problem that is important in the modern technological society. Studying requires broad knowledge in the field of engineering sciences (electronics) and teaching pedagogy, in which Tsvetelina Ivanova has a sufficiently good preparation.

The formulation of the goal and research tasks is made clear and specific and is subordinate to the topic of the research. The PhD student aims to develop and research systems of technology-based decisions that are relevant to engineering education. This was done through a detailed determination of the specifics of engineering education, on the basis of which a model was proposed for conducting laboratory classes on topics from electronics. The effectiveness of the proposed model, which is a well-structured didactic system, was evaluated through an experimental study.

4. Knowing the problem

The description in Chapter 1 of the different teaching methods, with priority importance for engineering education, is correctly and competently interpreted in the context of the dissertation thesis. A deep knowledge of both the traditional system of teaching methods and some of the new educational technologies is demonstrated. The various digital technologies and software tools for integrating technology-based methods into the educational process are convincingly described.

The PhD student demonstrates skill in creative inquiry and purposeful assessment of a rich literary material. 92 scientific sources were used, of which 79 were in English. Citation is done accurately and in the right places.

The built educational model described in Chapter 2 is specified through 3 (three) of its applications, presented in the Appendix to the dissertation. A good impression is made by professional knowledge of both pedagogical and specific engineering terminology, through

which the proposed training systems are described and justified. In the presented scenarios for conducting the electronics laboratory exercises, the doctoral student demonstrates pedagogical competence for the implementation of laboratory work and a good knowledge of various digital platforms and software environments.

In summary, I think that Tsvetelina Ivanova-Varadinova demonstrates the necessary scientific competence and sufficient depth of understanding of the topic and the process of conducting a scientific research. She demonstrates that she is able to process results, interpret statistical values and formulate logically based conclusions.

5. Research methodology

The selected research design is consistent with the set goal and the tasks of the dissertation research. Theoretical and empirical scientific methods have been used synchronously and complementarily. The dissertation research is in the amount of 164 pages and 3 (three) applications. It is organized into an introduction, four chapters, and a description of the contributions, a list of the doctoral student's publications, a bibliography and an appendix. As a result of the analysis and synthesis of the literary sources, a detailed overview of the problem was made in the Introduction, First Chapter and Second Chapter. In Chapter Four, the didactic dimensions of the following empirical methods - surveys, interviews, and pedagogical observation, have been presented, seeking their practical application in the dissertation research. Statistical approaches were used to present and evaluate the empirical results.

The conducted author's experiment on the effectiveness of the three training models for the formation of competence for technology-based decisions in engineering education is another proof of the correctly selected and successfully implemented research methodology.

6. Characterization and evaluation of the dissertation work

The dissertation research is predominantly practical-applied character. There is a well-defended internal logic in the structuring of the dissertation. In the **Introduction**, the relevance and motives for undertaking the dissertation research are clearly and correctly outlined.

The focus of the theoretical analysis in **Chapter One** is the understanding of technology-based solutions. Here, the characteristics of the teaching methods that have the

greatest application in engineering education are described in sufficient detail. The limitations and differences between the considered training methods are precisely outlined and successfully systematized in tables based on appropriately selected criteria. There is also a very good analysis of these methods based on modern digital technology in the context of cutting-edge learning models such as STEM, STEAM and STREM.

In this chapter, assistant professor Ivanova-Varadinova has made a comparative characterization of several key aspects between the most used technology-based learning methods in engineering education (3D modelling and design, Internet-based task support systems (IPSS), computer-based learning programs and algorithms and with interactive learning materials and multimedia) and traditional learning. Some of the main features and functionalities of web-based learning resources and platforms are thoroughly described by comparison with the traditional training that is required in the construction of remote laboratory exercises.

The theoretical consideration of "self-efficacy in technology-based decisions in engineering education" is made in the context of scientific research, emphasizing its role as an important indicator of the development of skills for successful problem solving, decision-making and the possibility of option. The integrity of "science-business-academic training" is argued, which transforms engineering education and directs it to the formation of a skill for effective technology-based decision-making, not only in the study of engineering sciences, but also in terms of the educational process itself for the creation and the use of new learning digital resources based on the latest and most advanced technologies. In this chapter, the doctoral student's understanding of the important characteristics of different types of decisions and of the essence of the specialized system of technology-based decisions in engineering education is presented.

Through the theoretical analysis, the doctoral student has shown good knowledge and skilful use of the experience of the Faculty of Physics and Technology in the application of the educational platform DIPSEIL, QR codes and AR.

In the **Second chapter**, the choice of a research model of a system of technology-based decisions in the education of students, future engineers from various professional fields is justified. The described model includes the following components: a system of laboratory exercises in electronics and a methodology for conducting them, building remote access to the laboratory and carrying out research and analysis of the results of the pedagogical experiment.

Here, the choice of methods for assessing students' knowledge and attitudes towards technology-based decisions is argued. The three different learning methods selected are described in sufficient detail: face-to-face, remote access and remote through simulations. The pedagogical characteristics of the two selected main technology-based learning methods - remote access learning and remote learning through simulations are thoroughly presented, thereby arguing for their choice as the object of the study. The described combinations of software and hardware tools, as well as various instruments that provide diverse simulation capabilities in many areas of engineering education, have significant practical value.

The empirical study is aimed at evaluating the effectiveness of the built model in the educational practice when conducting the following laboratory exercises using the three described methods: "Investigation of the transmission characteristics of bipolar transistors", the practice of the educational process", "Amplifiers with bipolar transistors" and "Construction and investigation of an analog-to-digital converter (ADC) with uniform step variation of the compensation voltage'. The learning scenarios of these classes are presented in their full form in the appendices.

The **Third chapter** describes the methods for researching the results of the application of technology-based decisions in engineering education. This describes the built-in remote access system, comments on the connection between the NI ELVIS III platform and the Measurements Live client application for conducting real-time measurements.

In the **Fourth Chapter** "Analysis of the results" the results of a didactic experiment are presented, which aims to check the qualities of the constructed model of technological but-based decisions in practice by teaching students from the Faculty of Physics and Technology of Plovdiv University. The results of the survey are presented in tables and in graphs with the corresponding qualitative and quantitative analysis, as well as conclusions from the conducted interviews, from the pedagogical observation and from the application of creative strategies for making technology-based decisions.

I appreciate the great amount of work done by the PhD student in collecting data, framing the results and drawing conclusions. I believe that here she has demonstrated the ability to conduct and analyse empirical pedagogical research.

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

The dissertation is a completed theoretical-empirical study with significant practical-applied value. The research work carried out by the doctoral student is labour-intensive and shows the presence of interdisciplinary knowledge and skills and readiness to carry out a scientific research.

The contributions presented in the dissertation correspond to the research work actually carried out and correspond to the purpose of the research tasks set. They are predominantly applied in character and are essentially an innovation for modern engineering education. In my opinion, the most significant contribution of doctoral student Tsvetelina Ivanova-Varadinova is in enriching the training methodology of future engineers in the direction of digitalization and distance learning.

8. Evaluation of the publications on the dissertation work and the personal participation of the doctoral student

The number and quality of the publications fully correspond to the requirements of the PU "Paisii Hilendarski" and the Faculty of Physics and Technology for Public defence of the dissertation.

The doctoral student presented a total of 8 (eight) scientific publications on the topic of the dissertation research, which are in English. Two of the publications are single-authored, while the rest are co-authored (in five of them, the first author). They examine various aspects of technology-based decisions and the research conducted on self-efficacy in face-to-face, hybrid and online learning.

The presented publications adequately represent the individual stages of the author's work on the theoretical and empirical part of the research and can be considered as evidence of her personal participation in the dissertation research. The writing style is the same in all publications, the abstract and the dissertation.

In conclusion, I believe that the submitted documents and publications, as well as the dissertation work and the contributions presented therein, are the result of independent research activity of Tsvetelina Ivanova-Varadinova.

9. Abstract

I certify that the abstract reflects in a summarized and short version all the most important parts of the dissertation work. It is presented in a volume of 32 pages and in two languages - Bulgarian and English. It is well structured and technically excellent.

10. Critical remarks and recommendations

I have no critical notes on the proposed dissertation for review. I have certain recommendations, which are wishful thinking and do not detract from my assessment of the high quality of the dissertation research conducted. For example, it is good to make a more detailed comparison between the characteristics of project-based and problem-based learning in engineering education. I think the technical layout needs a bit more effort (using bullets for better structure, avoiding some punctuation gaps, etc.) to give the thesis an even more polished look.

I recommend that the PhD student apply the created and tested educational design for technology-based decisions in engineering education to the three described learning models (face-to-face learning; distance learning with simulations and remote access) and to more topics not only for the electronics course, but also for other engineering disciplines.

11. Personal impressions

Tsvetelina Ivanova-Varadinova was my student during her Master's degree studies, and I have wonderful impressions of her active participation and excellent results during the courses. Since 2020, she has been an assistant in the "Educational Technologies" Department, of which I am the head. I can confidently say that she is a very disciplined, responsive, modest and respected colleague. She is a beloved educator who applies modern technological solutions in teaching with the aim of high quality education. As a young scientist, she is purposeful and consistent with a flair for innovation.

12. Recommendations for future use of dissertation contributions and results

I would like to make some recommendations regarding the scientific and teaching activities of the candidate. I advise assistant professor Tsvetelina Ivanova-Varadinova to direct her future scientific research to:

- Development of a model for technology-based decisions in the education of physicists and future science teachers, in which conducting laboratory classes is an important part of the training;

- Enrichment of the model developed by her through the integration of artificial intelligence as the latest manifestation of the digital revolution.

In order to popularize the results of the research and its benefits, I advise the PhD student to prepare a publication on the content of the dissertation for the scientific periodical, referenced and indexed in the world database Web of Science and Scopus.

CONCLUSION

The dissertation *contains 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), the Regulations for the Implementation of ZRASRB and the relevant Regulations of PU "Paisii Hilendarski".

The dissertation shows that the doctoral student Tsvetelina Lachezarova Ivanova-Varadinova **possesses** in-depth theoretical knowledge and professional skills in the scientific specialty "Automation of areas from the intangible sphere (medicine, education, science, administrative activity, etc.)" **by 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 honourable scientific jury to award the educational and scientific degree "**doctor**" to **Tsvetelina Lachezarova Ivanova-Varadinova** in field of higher education: 5 Technical sciences professional direction: 5.3 Communication and computer technology, doctoral program: "Automation of fields from the intangible sphere (medicine, education, science, administrative activity, etc.)".

Plovdiv, 08.05. 2024

Reviewer:

(Prof. Dr. Zhelyazka Raykova)