REVIEW

by Acad. Ivan P. Popchev

of dissertation for scientific degree "**Doctor of Science**"
In professional direction **4.6 "Informatics and Computer Sciences"**
Titled "Application of data science in the virtual educational space"
by **Prof. Daniela Ananieva Orozova, PhD**

By order No 253 /02.10.2023 of Sv. Margenov – the Director of IICT-BAS in accordance with art. 30 par. 2 of the Regulation on the Implementation of the Development of Academic Staff in Republic of Bulgaria Act and by decision of Scientific Council of IICT (protocol No 9/ 28.08..2023) in connecting with the procedure for acquiring the scientific degree "Doctor of Science" in professional direction 4.6 "Informatics and Computer Sciences" by Prof. Daniela Ananieva Orozova, PhD with dissertation" Application of data science in the virtual educational space" I am appointed a member of the Scientific Jury.

For the evaluation of the dissertation paper, the conditions of the Act of Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulation on the Implementation of the Development on Academic Staff in Republic of Bulgaria Act (RIDASRBA) (Decree No 202 of 10.09.2010 ammend and supl. SG 15/19.02.2019) and the Regulation on the specific conditions in the IICT for implementation of the law are defined and will therefore be accurately transmitted:

1. According to Art. 12(4). The dissertation paper must contain theoretical conclusions and solutions of major scientific and applies scientific problems, which correspond to the up-todate achievements and can be regarded as a considerable and original contribution to science.

2. According to the Regulations on the specific conditions in the IICT-BAS: Candidates for the Doctor of Science degree must have at least 15 publications with IF/SJR and 50 citations in WoS/Scopus.

On page 9 of the "Introduction" is 2. **Purpose and tasks of the dissertation work: „theoretical summaries of the processes of observation and analysis of data from the dynamic interaction of objects and the creation of methods and models for solving scientific or applied scientific problems in the virtual educational space".**

To achieve the **goal**, the following **four tasks** are set:

• Analysis of the application of tools for extracting knowledge from the data in the learning spaces and search for solutions for the personalization of e-Learning and distance learning.

• Creation of methods for evaluating and predicting the knowledge, skills and competences of learners in the virtual educational space.

• Creation of models, as a result of theoretical summaries of the processes of observation and analysis of the activities of learners related to Big Data Analytics, Data Mining, Web metrics, Generalized net, Machine Learning and Fuzzy logic.

• Introduction of basic modules and tools of Data Science for solutions of applied scientific problems in education.

The dissertation is 190 pages long, 49 figures, the bibliography covers 220 sources and includes:

• Introduction (5 – 10).

• Virtual educational space (chapter 1, 11 – 34).

• Means of the virtual educational space (chapter 2, 35 – 47).

• Models for data analysis in the virtual educational space (chapter 3, 48 – 104).

• Generalized net models in a virtual educational space (chapter 4, 105 – 145).

• Solutions of scientific applied problems in education (chapter 5, 146 – 165).

• Conclusion. Dissertation Contributions (166 – 169).

• Bibliography (178 – 190).

In the "**List of scientific publications on the topic of the dissertation**" (171 - 177 pages), there are 41 publications in English:

- 15 publications are in journal articles or series;

- 26 publications are from conference reports.

A list of 66 citations of 23 publications from the list on the topic of the dissertation work, in the scientific databases Web of Science and Scopus, is presented, excluding all self-citations.

An analysis of these publications shows the following:

Номер	Изисквания	**брой**	IF (брой)	SJR (брой)	WoS	Scopus	Изисквания ИИКТ-БАН
1	Публикации	**41**	3	17	28	37	15 с IF/SJR
2	Цитирания	**66**	Q2-4, Q4-7	48	31	60	50
3	Издаден учебник	**1**	-	-	-	-	-

All publications are in the interval 2014 – 2023 and are distributed in time like this:

2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
1	-	3	2	9	8	8	7	1	2

The analysis of the "List of publications" and "List of citations" categorically proves that Prof. Dr. Daniela Orozova fulfills the requirements for a "Doctor of Sciences" according to the "Regulations for the specific conditions in IICT -BAS".

The obtained **summaries and solutions** can be briefly systematized into two groups: scientific and scientific-applied.

A. Scientific (in the class enrichment of existing knowledge)

Methods and models are proposed, as a result of theoretical summaries of the processes of observation and analysis of the activities of learners, which can be used for research, analysis and training:

A1. Methods for evaluating and predicting the knowledge, skills and competencies of learners in the virtual educational space, with the possibility of applying computational models and criteria for dynamic evaluation [6-SJR/17], [27--/7].

A2. Fuzzy logic models of hierarchical multi-component assessment of different high- and low-order thinking skills, theoretical knowledge and practical skills [9-SJR/1], [13-SJR/-].

A3. A method with Web metric and inductive fuzzy classification for evaluating the degree of use of web resources by learners, when analyzing their behavior in the learning environment and the web space [34--/-]. A method for document type analysis based on classification algorithms [30--/-].

A4. A learner modeling method to track change in knowledge, skills and competencies and make predictions [8-SJR/6], [15-SJR/0].

A5. Generalized net models:

- with the ability to track the processes of using various tools in e-learning environments and applying Data Mining tools [2-IF,SJR/1], [3- IF,SJR/-], [22--/1], [24--/1], [40--/3];
- of the multi-component assessment process with the possibility of personalizing the way of forming tests through meta-models [1- IF,SJR/1], [6-SJR/17], [29--/1];
- of processes in project-based learning and opportunities for integration with electronic and web-based learning and gamification of an E-learning course [4-SJR/2], [39--/1];
- models for quality assurance and accreditation in higher education [14-SJR/4], [23--/3].

A6. The results of the conducted research and analysis of the main components and characteristics of the educational space presented in the publications are summarized [10-SJR/6], [11- SJR/0], [12-SJR/0], [27--/7], [28--/1].

B. Scientific-applied (in the class application of scientific achievements in practice)

Software tools are proposed and experiments are performed:

B1. A system has been developed to monitor and collect data for learners, using Orange Data Mining System machine learning tools [6-SJR/17], [16-SJR/-].

B2. Software tools for analyzing and comparing the behavior of two machine learning agents: Rule-Based System and Reinforcement Learning [21--/1].

B3. Software tools for analyzing sound frequencies and converting them to colors in the RGB model to help hearing impaired users [41-SJR/-].

B4. Basic modules of curricula of data science in disciplines of Higher Schools [18--/1] and methodological techniques for teaching students with tools for extracting knowledge through examples of real problems and tasks for designing and introducing ontologies in the education of students [5-SJR/2], [7-SJR/3], [19--/1], [36--/1].

The publications are given according to the numbering from the List of publications, on the topic of the dissertation work (pages 171 – 177). Each publication must include the following entry: [X-IF,SJR/citations], which categorically defines its correspondence to "**state of the art**" and **contribution to science**.

I have known Prof.. Daniela Orozova PhD as a teacher, researcher and organizer for many years.

In 2001, she defended her dissertation on the topic "Intelligent databases and training systems" in the scientific specialty 01.01.12 "Informatics".

From 04.11.2005 she was elected as an "**associate professor**" in the scientific specialty 01.01.12 "Informatics", and I was a **reviewer** of the procedure.

Since 27.04.2012, she holds the academic position "**professor**", in professional direction 4.6 "Informatics and Computer Sciences" and I was a **reviewer** for the procedure.

Prof. Orozova conducts active teaching-methodical and scientific-research activities with the students. **She is the head of the "Software Engineering" major at Trakia University.**

As a generalized "**scientific image**" of Prof. Daniela Orozova PhD, the world's scientific databases show the following:

Web of Science: 38 publications, 64 times cited without self citations, h-index 5;

Scopus: 116 cited documents, 193 total citations without self citations, h-index 8;

Google Scolar: 701 citations, h-index 12, i10-index 24;

Research Gate: 258.9 Research interest score, 369 citations, h-index 9;

zbMath: 11 publications;

IEEE Explore: 24 publications, 50 citations.

All this shows that Prof. Daniela Orozova is a researcher with sustainable development, results and recognition in our country and abroad.

The Abstracts are in Bulgarian (60 pages) and English (60 pages), respectively and present the dissertation paper.

CONCLUSION

The dissertation paper meets the conditions of the ADASRBA, the RIDASRBA and the Special conditions of the IICT-BAS.

I give a **positive conclusion** for acquisition of the scientific degree "**Doctor of Science**" of **Prof. Daniela Ananieva Orozova PhD**.

I propose to the Scientific Jury to vote unanimously for Prof. Daniela Ananieva Orozova PhD the scientific degree "Doctor of Science" on professional direction 4.6 "Informatics and Computer Sciences".

17.10. 2023