

## **REVIEW**

**under the procedure for acquisition of the educational and scientific degree “Doctor”**

by candidate **Dafinka Savova Miteva,**

**of the PhD Thesis entitled: “Big Data Visualization”,**

In the Scientific field: **4. Natural Sciences, Mathematics and Informatics**

Professional field: **4.6. Informatics and Computer Sciences**

Doctoral program **“Information Technologies (Information and Communication Technologies)”**,

Department **„Information Technologies“**

**Faculty of Mathematics and Informatics (FMI),**

**Sofia University “St. Kliment Ohridski” (SU)**

The review has been prepared by: **by Prof. Daniela Ananieva Orozova, PhD**, Trakia University, as a member of the scientific jury for the defense of this PhD thesis according to Order № ПД-38-153/03.04.2023 of the Rector of the Sofia University. The presented set of materials is in accordance with the regulations on the terms and conditions for acquiring scientific degrees and holding academic positions in SU “St. Kliment Ohridski”.

### **1. General characteristics of the dissertation thesis and the presented materials**

The author of the dissertation is Dafinka Savova Miteva – a Ph.D. student in part-time education at the department “Information technologies” of the Faculty of Mathematics and Informatics at the Sofia University “St. Kliment Ohridski“, with supervisor Prof. Eliza Stefanova PhD.

Dafinka Miteva's dissertation on "Big Data Visualization" is 148 pages long (125 pages of main text and six appendices). The text is structured in an introduction, seven chapters, conclusion, author reference (Contributions, publications, Participation in research projects, Declaration of originality), Bibliography and six appendices. Bibliography covers 105 titles, of which 103 are in

English, 1 in Ukrainian and 1 in Bulgarian. The text includes 102 figures and 9 tables. A glossary with explanations of the main terms and abbreviations is attached.

The purpose of the research is clearly defined on page 3 of the dissertation: „to design a learning analytics system in which, through modern visualization methods, ways to increase the effectiveness of e-learning can be outlined and to support learners, teachers and managers of educational institutions in making the right decisions at the right time“.

Seven tasks have been defined that correspond to the goal and are a good guide for conducting the research. The first four tasks are related to research and analysis of: the challenges to creating a system for visualizing learning analytics; how learning analytics methods and tools optimize the learning process; the functionalities of the virtual dashboard as a means of visualizing learning analytics; systematization of user expectations. The next three tasks are about creating a model of a visualization system, a prototype of a learning analytics system, and testing the created prototype.

In the introduction, the actuality of the problem is presented and the necessity of conducting the research is justified. Chapter 1 provides an overview of the different types of learning analytics and their use in education, as well as metrics and key performance indicators. The main ethical norms and requirements for the protection of personal data are considered. Chapter 2 presents conducted experiments looking at how the application of various learning analytics optimizes the learning process by supporting teachers, managers and learners. Chapter 3 describes experiments with different visualization methods created and used in different research projects within the dissertation. Chapter 4 presents the requirements for creating an integrated system for learning analytics, obtained as a result of two studies conducted on: the expert opinion on using large volumes of data for the benefit of learning and the view of experts on which visualizations allow fast and accurate perception of these data. Chapter 5 presents an architectural model of a learning analytics visualization system that meets modern requirements for an integrated system supporting learning management through better visualization. Chapter 6 presents the model prototyping process, describes the data and metrics that are visualized. The creation of a ready-made virtual dashboard and a template for a virtual dashboard is presented. Chapter 7 describes the two testing methods carried out in the dissertation. First, tests of the developed eAnalytics functionalities are presented in three variants (opening a template for a virtual dashboard and configuring it to work with real data sources, testing a ready-made virtual dashboard and creating a customized virtual dashboard). This is followed by testing with a think-aloud protocol, where each participant completes test tasks on a ready-made virtual whiteboard and shares each thought out loud. The

methodology of real data anonymization is described and the obtained results are illustrated. In the conclusion, a summary of the problems posed is made, the results obtained are noted and perspectives for future development of the subject are formulated. Six appendices provide additional material and references related to the research conducted.

The dissertation work is in the field of data processing systems, in particular learning analytics and their visualization. The analysis of the current state of scientific research in the field and the literature review made in the first chapter, the large number of literary sources studied, as well as the conclusions drawn give me reason to conclude that the doctoral student has a thorough knowledge of the problems related to increasing the effectiveness of e-learning and supporting of learners, teachers and managers.

## **2. Short CV and personal impressions of the candidate**

Dafinka Miteva has a **master's** degree in informatics since 2003 at Faculty of Mathematics and Informatics, Sofia University "St. Kliment Ohridski". She has been a **doctoral student** since 2014. She **worked** as a part-time assistant and head of the "Service of the educational process and scientific activity" department at the University Computing Center of SU, later as Chief Specialist in Personal Computers and System Administrator at the Information Service Laboratory. From 2018 until now, he is the head of the "Electronic and distance learning" sector at the FMI Information Service Laboratory at SU.

I do not know the candidate personally. From the published materials and submitted documents, my impressions of Dafinka Miteva are entirely positive.

## **3. Content analysis of the scientific and applied achievements of the candidate, contained in the presented PhD thesis and the publications to it, included in the procedure**

I accept the main results and contributions indicated by the Ph.D. student on page 115 of the dissertation. The contributions have a scientifically applied, and applied character.

Learning analytics in education, metrics and KPIs used, learner data collection methods and learning analytics implementation models and their role in enhancing the quality of teaching and learning are explored. Methods for visualizing large volumes of data and tools for visualizing learning analytics are explored. Modern platforms for creating a virtual dashboard are analyzed (in chapter 1).

An experimental analysis of the application of different methods and approaches for learning analytics has been made and tools for their visualization regarding users with different roles - learner, teacher and manager - have been studied (in chapters 2 and 3).

Learning analytics and their visualizations expected by users of a learning management system have been analyzed and systematized (in chapter 4).

A model of a learning analytics visualization system has been developed that maximally covers the users' requirements (in Chapter 5). A prototype of the learning analytics visualization system model was created (in Chapter 6). The experimentally created prototype of a virtual board, part of the learning analytics system, was tested (in chapter 7).

The realization of the dissertation requires in-depth scientific knowledge and high scientific and practical qualification, which its author undoubtedly possesses. This is evident from the ease with which the doctoral student argues and presents the main theses in the individual chapters of the dissertation work and the publications accompanying the dissertation.

#### **4. Approbation of the results**

The results of the dissertation research are presented in 6 publications in peer-reviewed publications: 1 publication in a specialized journal - International Journal of Human Capital and Information Technology Professionals (IJHCITP), 4 publications are reports from international scientific conferences and 1 publication from a national conference. Five of the publications are in English. Three of the publications are indexed in the scientific database Scopus, (one publication has SJR). All publications are co-authored, with the PhD student as the first author.

A good impression is made by the volume and depth of the publications, which comprehensively reflect the main aspects of the issues considered in the dissertation.

The presented publications are distributed over time as follows:

<b>Year</b>	2016	2017	2018	2020
<b>Number</b>	1	1	2	2

The works presented go beyond requirements of the Development of Academic Staff Act in the Republic of Bulgaria, the Rules for its Implementation and the corresponding Rules at the Sofia University "St. Kliment Ohridski" for acquisition by the candidate of educational and scientific degree "Doctor".

A list of the 8 scientific projects in which the author conducted the scientific experiments and research related to the dissertation work is presented.

After a detailed review of the presented scientific works, I found that:

a) The scientific works meet the minimum national requirements (according to Art. 2b, para 2 and 3 of the Development of Academic Staff Act in the Republic of Bulgaria) and respectively to the additional requirements of Sofia University “St. Kliment Ohridski” for acquiring the educational and scientific degree “Doctor” (Ph.D.) in the scientific field and professional field of the procedure.

b) The results presented by the candidate in the dissertation work and scientific works to it do not repeat such from previous procedures for acquiring a scientific title and academic position;

c) There is no plagiarism proven in the legally established order in the submitted dissertation work and scientific papers under this procedure.

## **5. Qualities of the abstract**

The Bulgarian and English abstracts meet the requirements' volume and content for accurate, complete, and concise coverage of the dissertation.

## **6. Critical notes and recommendations**

I do not find any gaps in the structuring of the content, the accuracy and completeness of the description, as well as in the design of the presented documents for the dissertation work. The documents show a successful and productive research activity of Dafinka Miteva.

The doctoral student has the following two questions:

- Which characteristics of the data processed by the systems, connects them to the Big Data category?
- Is the created prototype accessible to a wider group of users? Where and how can access be obtained?

I recommend the doctoral student to continue the research by expanding the applicability of the results of the dissertation work. The field of research in the field of learning and data processing systems is wide and fertile.

## 7. Conclusion

Having become acquainted with the PhD thesis presented in the procedure and the accompanying scientific papers and on the basis of the analysis of their importance and the scientific and applied contributions contained therein, I confirm that the presented PhD thesis and the scientific publications to it, as well as the quality and originality of the results and achievements presented in them, meet the requirements of the ADAS in the Republic of Bulgaria, the Rules for its Implementation and the corresponding Rules at the Sofia University “St. Kliment Ohridski” (FMI-SU) for acquisition by the candidate of educational and scientific degree “Doctor” in the Scientific field 4. Natural Sciences, Mathematics, and Informatics, Professional field: 4.6. Informatics and Computer Sciences. In particular, the candidate meets the minimal national requirements in the professional field and no plagiarism has been detected in the scientific papers submitted for the competition.

Based on the above, **I strongly recommend** the scientific jury to award **Dafinka Savova Miteva**, the educational and scientific degree “Doctor” in the Scientific field 4. Natural sciences, mathematics and informatics, Professional field 4.6. Informatics and computer sciences, Doctoral program “Information Technologies” (Information and Communication Technologies).

Date: 18.05.2023

Reviewer: .....  
/ Prof. Daniela Orozova, Ph.D./

*\*ADASRB - Act on Development of the Academic Staff in the Republic of Bulgaria*