

REVIEW

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

by candidate Albena Emilova Antonova,

**of the PhD Thesis entitled: “Smart Services for Development of personalized and
adaptable educational video-games”,**

In the Scientific field: 4. Natural Sciences

Professional field: 4.6. Informatics and Computer Sciences

Doctoral program “Information Technologies”, Department „Information Technologies”,

**Faculty of Mathematics and Informatics (FMI), Sofia University “St. Kliment
Ohridski” (SU),**

The review has been prepared by: **Prof. Evdokia Nikolaeva Sotirova, PhD,**
as a member of the scientific jury for the defense of this PhD thesis according to Order №
RD 38-115/07.03.2023 y of the Rector of the Sofia University.

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

1.1. General characteristics of the submitted materials.

The materials submitted by Albena Antonova contain: an application to the Head of the Department of “Information Technologies”; a PhD dissertation; an abstract of the dissertation in Bulgarian and English; a report on the fulfilment of the minimal national requirements for the educational and scientific degree “Doctor”; a report from the supervisors on the opening of a preliminary discussion procedure; a declaration of originality; a similarity report from the electronic anti-plagiarism system available at the Sofia University, confirmed by the supervisor; a protocol for checking the originality of the dissertation prepared by the supervisors; a statement from the supervisors in relation to the procedure for preventing plagiarism; a reference to the scientific publications and noted citations; an order for the doctoral student's enrolment; certificate of passing the examinations; order for dismissal with the right to defend; order for the expansion of the composition of the Department of Information Technology in connection with the discussion

of the dissertation; internal review and presentation for preliminary defense; evidence regarding the publications of the doctoral student.

The submitted materials have been carefully arranged in accordance with the requirements of the Regulations on the Conditions and Procedure for Acquisition of Scientific Degrees and for Holding Scientific Positions at Sofia University "St. Kliment Ohridski".

1.2. General characteristics of the PhD dissertation.

Albena Emilova Antonova's PhD dissertation is an original scientific research focused on intelligent services for creating personalized educational video-games. It is structured in a volume of 170 pages, contains an introduction, five chapters, a conclusion, an author's reference, a list of used literature and appendices. The content is illustrated with 55 figures and 10 tables. The bibliography includes 138 references, all in English, 1 of them published in 2023, 37 are from the last five years (2018-2022).

The *Introduction* (8 pages) motivates the choice of the topic, presents the used methods, existing limitations and describes the structure of the PhD dissertation. On page 14, the aim of the development is defined, namely "*to investigate, propose, develop and validate intelligent services supporting the creation of personalized and adaptive maze-type educational video-games enriched with mini-puzzle games*". To achieve the aim, five main tasks are defined. In *Chapter one* (26 pages), following the set tasks, the main theoretical concepts for the development of intelligent services are competently presented and the possibilities for the use of educational games, the problems and limitations for teachers in their creation and use in teaching are analysed. In *Chapter Two*, within 24 pages, the doctoral student has competently presented the concepts and processes of personalizing learning and the possibilities of adapting game-based learning to support the teacher. A conceptual model of intelligent services supporting tutors is proposed. *Chapter Three* (21 pages) presents a basic model of intelligent services approaches for designing personalized and adaptive educational video-games for specific educational scenarios and a specialized intelligent services model based on it, designed for educational video-games of the enriched maze type. Building on her theoretical research in *Chapter Four* (14 pages), the PhD student has presented a pilot model for the implementation of intelligent services for the creation of educational video-games of the enriched maze type and an approach for an iterative process of working with the functionalities of the APOGEE platform. *Chapter five* (18 pages) is devoted to the methodology of validation of intelligent services to support the teacher, the results of the validation of the developed intelligent services among teachers and students are analyzed. I find useful the systematised links between the characteristics of smart services and knowledge

management processes and the presented implications for the development and implementation of smart services. In the *Conclusion*, a summary of the results is provided and directions for future work are presented. In an *Author's Note*, the contributions of the work are structured, the publications and participations in projects of the PhD student are presented, and a declaration of originality is attached. *Five appendices* (29 pages) are presented at the end of the PhD dissertation.

The PhD dissertation is very well developed and thoroughly illustrated. The critical analysis of the problem area shows the PhD student's good knowledge. The research has been done thoroughly following the set objectives. A clear and competent scholarly style has been used.

2. Short CV and personal impressions of the candidate

Albena Antonova was born on 30.05.1978. In 2001 she graduated in Bachelor's degree in Business Administration at the Faculty of Economics of Sofia University. In 2002 she graduated in the Master of Business Administration at the University of Nantes, France. In December 2019, she was enrolled in the PhD program "Information Technologies" at Sofia University "St. Kliment Ohridski". In the period 2004-2009 and from 2017 to the present, she has been working as a collaborator - international projects expert at the Center for Information Society Technologies at SU. Since October 2019 till now she is an assistant professor at the Department of Information Technologies, Faculty of Mathematics and Informatics, SU "St. Kliment Ohridski". In January 2023, Albena Antonova was dismissed with the right to defend her PhD dissertation.

I have no direct impressions of the PhD student's work. The reference I made in Scopus showed high scientific metrics of Albena Antonova - 42 scientific papers and h-index 6 excluding self-citations of all co-authors. The total number of publications of the PhD student visible in Google Scholar is over 100. In addition, Albena Antonova teaches 6 courses to undergraduate students, among them is "Application of Serious Games in Teaching".

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

In the PhD dissertation a comparative analysis of the capabilities of intelligent services to support educators and draws conclusions and recommendations for the development of intelligent services to support and facilitate educators in creating data-driven educational video-games and best practices is provided.

The methodology used by Albena Antonova to achieve the formulated goal and the corresponding tasks is appropriate, convincingly motivated and suitable for the successful implementation of the research. This is evident from the obtained original results and the scientific, applied and scientific contributions achieved. They can be summarized as follows:

- A conceptual model for intelligent tutor support services is developed to create personalized and adaptive learning scenarios for active learning methods and ways to use video-games in the learning process;
- A basic model for intelligent services has been developed for the application and development of personalized and adaptive educational video games according to specific educational scenarios;
- A specialized model for intelligent services for the creation of educational video games of the enriched maze type has been developed;
- A methodology for creating intelligent adaptive educational video games has been developed.

As applied contributions I can define:

- Implementation of the specialized model of intelligent services for the creation of specific educational video games of the educational labyrinth type;
- Successfully validating the use of intelligent services in the process of creating concrete educational maze-type video games among teachers and students and forming recommendations.

The doctoral student has carried out in-depth research and presented ideas for further research and improvement of the developed approaches and further development of the topic.

I believe that the PhD dissertation has been successfully implemented, significant results have been obtained with significant value in the development and implementation of intelligent services to help teachers, creation of approaches and scenarios for the development and use of video games in the learning process and the creation of personalized and adaptive educational video-games.

4. Approbation of the results

According to the *List of published and accepted scientific publications*, the results of the research in the dissertation have been published in 7 scientific papers (1 in press). One publication is independent, the others are co-authored, with Albena Antonova being the first author in all. This shows the personal contribution of the PhD student. In the co-authored publications,

considering also the attached co-authorship declarations, I assume equal contribution for each of the co-authors. Three of the publications have been indexed and refereed in Scopus and have an SJR index: [3] in Lecture Notes in Networks and Systems, [4] in the ACM International Conference Proceeding Series, awarded the "Best paper award", and [7] in In the Proceedings of ECKM 2020. The attached reference for fulfillment of the minimum requirements shows that with these three publications the PhD student obtained 90 points in *Group of indicators G* with the required 30 points, which satisfied the minimal national requirements and the requirements of SU "St. Kliment Ohridski" for obtaining the educational and scientific degree "Doctor". The other 4 publications of the PhD dissertation are distributed as follows: one is in the proceedings of a conference abroad ([5]), two - from conferences in Bulgaria ([1] and [6]); one is in the International Journal of Education and Learning Systems, indexed in Google Scholar ([2]). All publications are entirely on the topic of the PhD dissertation.

The PhD student has presented a reference for 10 citations of 4 of her publications on the PhD dissertation, which is a testimonial for the significance of the results achieved by the work.

The results presented by Albena Antonova in the PhD dissertation and the scientific papers accompanying it do not repeat those of previous procedures for academic position.

No plagiarism has been proven in the submitted PhD dissertation and scientific works.

I consider that the presented scientific works, their reflection in the research of other authors and applicability in the research of Albena Antonova in 4 international and national research projects is evidence of the successful approbation of the results obtained from her work.

5. Qualities of the abstract

The abstract has a length of 39 pages and includes 14 figures and 2 tables. I believe that it is well structured and prepared in accordance with the requirements of the Regulations for the conditions and procedure for the acquisition of scientific degrees and for the occupation of scientific positions at the SU "St. Kliment Ohridski". The abstract correctly reflects the content of the dissertation, the main points of the study, the obtained results and the drawn conclusions. The author's publications and participation in projects are also presented, as well as the guidelines for future research of the PhD student.

6. Critical notes and recommendations

Albena Antonova's dissertation and research work are up-to-date. PhD student demonstrates competence and very good knowledge of the problems related to the field of research. The obtained results are original and fully correspond to the goal set in the PhD dissertation.

I have no significant critical remarks.

The research in this PhD dissertation is mainly aimed at further improving the APOGEE educational video-game platform. I recommend Albena Antonova to continue her work in this direction.

I think it would be useful if the PhD student would direct her rich experience and knowledge towards exploring other possibilities for developing and implementing educational video-games and make platform-independent recommendations for their adaptation and customization.

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 Science.

The obtained results represent an original contribution to science and show that the PhD student possesses in-depth theoretical training, opportunities for critical analysis and independent research. 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 Albena Emilova Antonova the educational and scientific degree “Doctor” in the Scientific field 4. Natural Sciences, Mathematics and Informatics, Professional field 4.6. Informatics and Computer Science (Information Technology).

Date: 09.05.2023

Reviewer:

/Prof. Evdokia Sotirova, PhD/