REVIEW

by **Corresponding Member Lyubka Doukovska, DSc**
from the Institute of Information and Communication Technologies,
at the Bulgarian Academy of Sciences,
on the Thesis for awarding educational and scientific degree **PhD**,
under the Scientific Field: **4. Natural Sciences, Mathematics and Informatics,**
the Professional Area: **4.6. Informatics and Computer Sciences,**
the Scientific Specialty: **Informatics**

Author of the PhD thesis: **Ivaylo Zhivkov Blagoev**

PhD thesis title: **Development and delivery of personalized e-learning content**

In accordance with Order No. 326/20.12.2024 of the Director of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences, I have been appointed as a member of the Scientific Jury regarding the PhD thesis of **Ivaylo Zhivkov Blagoev** for awarding the educational and scientific degree "Doctor of Philosophy" (PhD) in the Scientific Field **4. Natural Sciences, Mathematics and Informatics**, the Professional Area **4.6. Informatics and Computer Sciences**, the Scientific Specialty **Informatics**. The scientific advisors are Prof. Vladimir Vassilev Monov, PhD.

As a member of the Scientific Jury I have received:

1. Order No. 326/20.12.2024 of the Director of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences;
2. Order No. 324/30.12.2019 of the Director of the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences;
3. Application for opening a procedure for acquiring the educational and scientific degree PhD;
4. European Curriculum Vitae;
5. List of the publications included in the PhD thesis;
6. Copies of the publications included in the PhD thesis;
7. Abstract of the PhD thesis;

8. Dissertation for the educational and scientific degree PhD;

9. Certificate of fulfillment of the minimum requirements of the Institute of Information and Communication Technologies, at the Bulgarian Academy of Sciences for awarding the educational and scientific degree "PhD" in the scientific field 4. Natural Sciences, Mathematics and Informatics, by professional area 4.6. Informatics and Computer Sciences;

10. Preliminary opinion on the PhD thesis, prepared by Prof. Stanimir Stoyanov, PhD.

In order to form the final evaluation of the dissertation, the requirements of the *Development of Academic Staff Act in the Republic of Bulgaria* are implemented the specific requirements in the Act's Institutional Regulation shall be taken into consideration, where the respective norms are:

1. Pursuant to Art. 6 (3) of the *Development of Academic Staff Act in the Republic of Bulgaria*, PhD thesis should contain scientific or scientific-applied results, which represent an original contribution in science. The PhD thesis must indicate that the candidate has in-depth theoretical knowledge of the relevant specialty and ability for independent research.

2. According to Art. 27 (2) of the specific requirements in the Act's Institutional Regulation, PhD thesis should be presented in a form and volume corresponding to the specific requirements of the primary unit. The PhD thesis should contain: a cover page; content; introduction; exhibition; conclusion - a summary of the results obtained with a declaration of originality; bibliography.

I. Actuality and significance of the PhD thesis.

The relevance of the PhD thesis is determined by the field of research presented, namely Artificial Intelligence. Artificial Intelligence is the science of the concepts, methods and means of creating intelligent models for the study of natural intelligence.

The PhD thesis submitted to me for review is dedicated to the development of methods and models, architecture and prototype of a system for personalized electronic educational content, through software solutions and artificial intelligence technologies.

The aim of the PhD thesis is „to propose a system and tools for the development and delivery of interactive personalized e-learning based on the learners' prior knowledge". To achieve the goal, the following tasks are defined:

1. A classification of the functional requirements should be carried out and a methodology developed for the evaluation of e-learning and knowledge management systems.

2. To make a classification of online training courses according to delivery methods and type of training content and to develop a content development approach for e-training courses.

3. To create a method for generating educational content, through generative Artificial Intelligence.

4. To develop a model for personalized e-learning based on the competence profile of the learner.

5. To design a tool for creating personalized e-learning content.

6. To develop the architecture and prototype of a web-based platform for the development and delivery of interactive educational content.

I find that the aim and the tasks formulated reflect the topicality and significance of the presented PhD thesis, as well as the possibility to apply the results obtained in the practice.

II. Summary of the PhD thesis.

The PhD thesis consists of 202 pages. Its structure includes a glossary of terms and abbreviations, an introduction, four chapters, a conclusion - a summary of the results obtained, a table of contents of the PhD thesis, directions for future research, a list of publications on the PhD thesis, a list of citations, a declaration of originality of the results, acknowledgements, a bibliography, a list of 53 figures and a list of 13 tables.

The introduction to the PhD thesis presents the need to develop and implement learning content according to the specific needs of the learner, which would lead to an increase in the effectiveness of the learning process.

In the first chapter "An analytical review of personalized e-learning", an analytical overview of the theoretical base related to the problem area of the

dissertation is made. It includes a brief introduction, relevance of the topic, applications, challenges and existing solutions of scientific research. The need to create and implement new models for personalizing the learning process in an online environment is motivated.

In the second chapter "Models and technologies for the development and delivery of personalized e-learning content", a classification of the functional requirements of the e-learning and knowledge management systems and an assessment of their effectiveness was carried out. A comparative analysis of the e-learning systems and e-learning tools existing on the market was made and their suitability for implementing personalized training based on the competence profile of the learner and his prior knowledge was assessed. A method for evaluating e-learning systems has been developed to reflect the specific needs of different types of organizations using e-learning for different purposes and in different technological contexts. Classification of online training courses according to delivery methods and type of training content was carried out. A content development standard for e-learning courses has also been developed.

The third chapter "System architecture for the development and delivery of personalized e-learning content" describes the process of developing a system architecture for the development and delivery of customized e-learning content. In the first section of the chapter, the architecture of the complex system is presented. In the second section, a model for personalized e-learning based on the learner's competency profile is developed, and in the third section, the architecture of a tool for creating personalized e-learning content is created, which is the basis for implementing the model of personalization of the learning process.

In the fourth chapter "A prototype system for the development and delivery of personalized e-learning content", a working prototype of a complex system for the development and delivery of personalized e-learning content is developed, which includes an integrated e-learning system and a tool for the development of interactive personalized learning content.

In the Conclusion, a summary of the obtained results of the development is presented. Directions for future research and development are identified. A list of scientific publications on the topic and noted citations is presented. A list of 21

citations is presented, and the reviewer assumes that this is the number of citations up to the time of submission of the PhD thesis and that there are newly appeared citations.

The cited 125 sources are sufficiently diverse and for the most part they are written by foreign authors. The presence of Bulgarian authors in the literature used also makes a good impression.

III. Evaluation of the PhD thesis's contributions.

During the achievement of the main goal and solving the tasks related to it, the following main results were obtained, and in summary:

1. A methodology has been developed for the evaluation of e-learning and knowledge management systems, and for this purpose a classification of the functional requirements of these systems has been carried out, it allows institutions and organizations to evaluate and compare different systems, thus choosing the best solutions according to their specific needs.

2. A classification of online training courses according to delivery methods and type of training content is made, and a content development approach for e-training courses is developed. Defining such an approach ensures high quality of the developed educational content and facilitates the integration of various tools used to create educational materials. This leads to greater consistency and improved interoperability between different systems and resources.

3. Created a method for generating training content, using generative AI. With this method, training materials can be customized according to the needs of each learner, making the learning process more efficient and adaptable. The created method based on artificial intelligence supports the creation of content tailored to the individual knowledge and interests of the learner, which is a step towards more personalized learning.

4. A model has been developed for personalized e-learning based on the competence profile of the learner. The model provides individualized training that takes into account the specific needs and competencies of learners and ensures higher efficiency and increased commitment of learners.

5. Based on the developed model, a tool for creating personalized e-learning content was designed. Creating a custom e-content tool also plays an important role in

this process. This tool facilitates the creation of adaptive content tailored to the individual needs of each learner by providing the necessary resources for personalization.

6. The architecture and prototype of a web-based platform for the development and delivery of interactive training content have been developed. A comprehensive system for the development and delivery of customized e-learning content is essential to bring all aspects of e-learning together. This prototype serves as the basis for an integrated solution that combines the creation, management and distribution of personalized training materials in one comprehensive platform.

The reviewer accepts the contributions formulated in this way in the PhD thesis, which can be considered as scientifically applied and applied. This division would allow for the detailed analysis of the results obtained according to the specifics of their significance.

IV. Assessment of the submitted publications.

Seven publications are included in the presented list of publications on the PhD thesis work. Five of the publications are referenced in the world databases SCOPUS and/or Web of Science, two are in journals with IF and/or SJR and three are in proceedings of IEEE conferences. Two publications are in the proceedings of the international conference - International Conference on Education and New Learning Technologies - EDULEARN, Palma, Spain.

The quality of the presented papers has been proven by their publication in specialized scientific journals and in proceedings of international conferences. The data presented in this way give me reason to conclude that the research has been provided with the necessary publicity among the scientific community.

The published results are original and I am not aware of any legally proven plagiarism in scientific works.

V. Evaluation of the PhD abstract.

The PhD abstract is consisting of 44 pages. It reflects the essence and content of the dissertation, including the purpose, subject, object and tasks of dissertation research and the ways of their realization.

VI. Remarks and recommendations.

In order to form the final evaluation of the PhD thesis, the requirements of the *Development of Academic Staff Act in the Republic of Bulgaria* and its Implementation Rules are to be taken into account, according to which I have the following remarks and recommendations:

1. Style errors are noted in the text of the PhD thesis.
2. The formulation of the PhD thesis contributions does not allow emphasizing the individual contribution of the PhD student.
3. The PhD student should direct his efforts to increase his contributions to reputable international publications.

VII. Conclusion.

I accept that the requirements of the *Development of Academic Staff Act in the Republic of Bulgaria* and the specific requirements in the Act's Institutional Regulations for its implementation, the Rules for the conditions and the order for acquiring academic degrees and for the occupation of academic positions in the Bulgarian Academy of Sciences and the Rules for the specific conditions for acquisition of academic degrees and occupation of academic positions at the Institute of Information and Communication Technologies at the Bulgarian Academy of Sciences are accomplished.

After my introduction to the PhD thesis and its publications, an analysis of their significance and the contributions they make, I give my positive assessment and I recommend to the Honorable Jury to award the educational and scientific degree "**Doctor of Philosophy**" (PhD) to **Ivaylo Zhivkov Blagoev** in the Scientific Field **4. Natural Sciences, Mathematics and Informatics**, the Professional Area **4.6. Informatics and Computer Sciences**, the Scientific Specialty **Informatics**.

На основание ЗЗЛД

20.01.2025 Signature: ...

Sofia

/Corr. Member Lyubka Doukovska/