

REVIEW

by Dr. Rositsa Zhelyazkova Doneva – Professor at Plovdiv University "Paisii Hilendarski"

on a dissertation thesis for the award of the educational and scientific degree "Doctor" (PhD) in the field of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.6. Informatics and Computer Sciences, Doctoral Program "Informatics"

Author: Maria Metodieva Gorgorova

Topic: "Intelligent Components in E-Learning Environments"

Supervisors: Prof. Dr. Stanka Ivanova Hadzhikoleva and Assoc. Prof. Dr. Silvia Nikolaeva Gaftandzhieva – Plovdiv University "Paisii Hilendarski"

1. General Description of the Presented Materials

By Order No. RD-22-1412 dated July 17, 2026, of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury to ensure the defence procedure of a dissertation thesis on the topic "Intelligent Components in E-Learning Environments" for the acquisition of the educational and scientific degree "Doctor" (PhD) in the Field of Higher Education 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.6. Informatics and Computer Sciences, Doctoral Program "Informatics". The author of the dissertation thesis is Maria Metodieva Gorgorova – a full-time PhD student at the Department of Computer Informatics, with supervisors Prof. Dr. Stanka Ivanova Hadzhikoleva and Assoc. Prof. Dr. Silvia Nikolaeva Gaftandzhieva from PU "Paisii Hilendarski".

The set of materials presented by Maria Metodieva Gorgorova complies with Art. 36 (1) of the Regulations for the Development of the Academic Staff of PU and includes the following documents:

- Application to the Rector of PU for opening a dissertation defence procedure;
- European format Curriculum Vitae (CV);
- Protocol from the Department Council meeting regarding the preliminary discussion of the dissertation thesis;
- Opinion of the supervisors regarding readiness for the preliminary discussion;
- Dissertation thesis;
- Author's abstract (in Bulgarian and English);
- List of scientific publications on the topic of the dissertation;
- Reference statement on the fulfilment of the minimum national requirements;
- Complete list of scientific publications;

- List of noticed citations;
- Copies of the publications on the topic of the dissertation thesis;
- Declaration of originality and authenticity of the attached documents.

The PhD student has attached 8 publications on the topic of the dissertation thesis.

2. Brief Biographical Data of the PhD Student

In 2022, Maria Gorgorova acquired a Bachelor's degree in "Software Technologies and Design" at PU. In the following year, she completed her Master's degree in "Business Informatics with English" at the same university. In 2024, she was enrolled as a full-time PhD student at the Department of Computer Informatics in the Faculty of Mathematics and Informatics (FMI) at PU, and as of July 1, 2026, she graduated with the right to defend.

In parallel, she upgraded her qualifications with two specialised courses: "Innovative Educational Technologies" at the University of Ruse "Angel Kanchev" (2024, under the National Program "Digital Qualification") and "Advanced Artificial Intelligence for Education" at the Europass Teacher Academy in Dublin, Ireland (2025).

Her professional path began in the period 2022–2023 as a graphic designer at MASTILO PRINT STUDIO, Plovdiv. Since 2022, Maria Gorgorova has been actively participating in the Department of Computer Informatics teaching activities, leading lab classes in the courses "Databases", "Software Technologies 2", "Software Project Management", and "Web Programming with PHP and MySQL". Since 2023, she has been delivering lectures and lab classes in "Interactive Design" at the Academy of Music, Dance and Fine Arts "Prof. A. Diamandiev" – Plovdiv.

Since September 2023, she has been working as a coordinator and organiser of scientific events at the Union of Scientists in Bulgaria – Plovdiv. From October 1, 2024, to June 30, 2025, she was also appointed as a researcher under the National Program "Young Scientists and Postdoctoral Students – Stage 2".

3. Relevance of the Topic and Expediency of the Set Goals and Tasks

The dissertation thesis is dedicated to a topical problem of significant importance for modern higher education – the need to modernise the learning environment in the context of global digital transformation. The PhD student identifies negative trends, including the decreasing effectiveness of traditional teaching methods, and substantiates the pressing need to implement innovative, interactive solutions to increase learners' motivation and engagement. To address these problems, Maria Gorgorova explores the possibilities of integrating intelligent and gamified technologies into e-learning environments, which corresponds to modern trends in pedagogical practice, and proposes

specific solutions for database education. The development of conceptual models, methodologies, and tools for their implementation in e-learning environments is a critical step towards building a modern, adaptive, and interactive educational environment, which indisputably conditions the relevance of this dissertation thesis.

The main goal, aimed at developing conceptual models, a methodology, and tools for designing and applying intelligent and gamified educational resources, is defined precisely and correctly. The five research tasks are logically linked and allow the achievement of the set goal.

4. Knowledge of the Problem

For her research, Maria Gorgorova has studied 169 literary sources. The bibliographic reference provides grounds to conclude that the PhD student is thoroughly acquainted with the state of research on the problem addressed in the dissertation thesis.

5. Research Methodology

The chosen research methodology is standard for a dissertation thesis in the field of informatics – literature review, conceptual modelling, software implementation, and experiments. Based on a study of existing modern learning approaches, research on learners' attitudes towards using artificial intelligence in education, a review of intelligent tools, best practices for the gamification of courses, and studies on the use of educational games, the PhD student concludes that a large part of modern e-learning environments function primarily as static repositories for learning content, which does not match the cognitive profile and expectations of modern learners. In this way, the PhD student successfully determines the existing research gap, which fully justifies the goal and tasks of this dissertation.

In the conceptual modelling stage, Maria Gorgorova defines clear criteria for the selection and integration of intelligent tools, proposes a methodology for creating educational mini-games with generative artificial intelligence, conceptual models of the games "SQL Escape Room" and "Temple of Data", as well as a model for integrating games into e-learning environments. The proposed game development methodology has been successfully applied to implement a set of educational games (flashcards, quiz games, puzzles, and fill-in-the-blank games, "SQL Escape Room", and "Temple of Data") for teaching the "Databases" course. A functioning prototype of a specialised module (plugin) has also been developed for integrating the created games into the Moodle platform. In the final stage, experimental studies were conducted to evaluate the effectiveness of the developed educational resources in a real educational process.

The chosen research methodology allows the achievement of the set goal and the execution of the tasks addressed in the dissertation thesis.

6. Characteristics and Evaluation of the Dissertation Thesis

The dissertation thesis (187 pages) includes an Introduction, 4 chapters, a Conclusion, and 3 Appendices presenting developed survey questionnaires used to evaluate student satisfaction with the developed educational games. The planned lists of abbreviations used, tables, figures, and literature references contribute to the clarity of the exposition.

In the Introduction, the PhD student introduces the research area and defines the dissertation's main goal and tasks. The tasks of the dissertation thesis are well-formulated and allow the achievement of the set goal: "to develop conceptual models and a methodology for designing, developing, and applying intelligent and gamified educational resources for higher education based on artificial intelligence technologies, tools for integrating developed resources into e-learning environments, as well as to experimentally evaluate their effectiveness in increasing students' motivation, engagement, and learning outcomes."

Chapter 1 has an analytical nature. It presents a systematic review of modern learning approaches (personalization of learning, integration of modern technologies, stimulating the development of soft skills, formative assessment, gamification, flipped classroom, ubiquitous learning, etc.), learning platforms, attitudes towards the use of artificial intelligence in educational institutions, applications of artificial intelligence in education, intelligent tools applied in training, means, and good practices for the application of technologies. The PhD student demonstrates good awareness regarding the practical application of technologies and their role in increasing the effectiveness of the educational process. This chapter builds the necessary theoretical foundation for subsequent research. It substantiates the need to integrate intelligent components (including adaptive educational games, chatbots, content generation tools, etc.) into e-learning environments.

Chapter 2 describes conceptual models for designing intelligent and gamified educational resources. The PhD student defines a set of criteria for selecting and integrating intelligent tools into e-learning environments. The criteria cover pedagogical requirements for adaptability, real-time feedback, and stimulating engagement, as well as technological and legal aspects, including data compatibility and GDPR regulatory frameworks, which shows a comprehensive view of the problem at hand. A methodology is proposed for creating educational mini-games using generative artificial intelligence tools, enabling instructors to develop games without possessing deep knowledge of software development. The four types of mini-games studied (flashcards, quizzes, puzzles, and fill-in-the-blanks) are correctly classified according to specific cognitive goals, which facilitates the personalisation of learning. The conceptual models for the games "SQL Escape Room" and "Temple of Data" demonstrate the PhD student's skills in developing interactive architectures for the spe-

cific needs of database education. The PhD student does a thorough comparative analysis of two approaches for integrating educational games into e-learning environments and shows objectivity by detailing the advantages and disadvantages of both approaches, including security vulnerabilities, administrative barriers to server-level installation, and long-term maintenance issues with new platform versions. The decision to develop a specialised Moodle plugin is fully justified given data protection and the direct connection to the gradebook.

Chapter 3 is dedicated to implementing the developed gamified educational resources. The technologies used are described, with the PhD student showing an understanding of the capabilities and limitations of existing platforms and generative tools. A working catalogue of educational mini-games is presented, with which experiments were conducted at PU, along with the implementation of the games "SQL Escape Room" and "Temple of Data", the latter of which communicates via a REST API and performs automated real-time checking of SQL queries. The chapter also presents the author's developed module "AI Games" (PHP 8.2) for the Moodle platform, which allows the addition of games as regular learning activities and is integrated with the Google Gemini 2.5 model for dynamic content generation. The flexible options for instructors to configure parameters, such as cognitive complexity and time limits, turn the development into a complete tool ready for empirical testing.

Chapter 4 describes the experiments conducted to evaluate the practical applicability of the developed educational resources in a real university environment. The PhD student clearly defines the exploratory and evaluative nature of the experiments – the results do not claim statistical exhaustiveness but aim to provide feedback on the developed software solutions, identify their strengths and potential areas for improvement, and confirm the practical applicability of the proposed conceptual models. The results of 3 experiments conducted during practical lab classes in "Databases" at the FMI of PU are presented. In the first experiment, the integrated Moodle AI plugins were tested (39 students), and the results prove that the virtual assistant successfully supports self-directed learning. Within the second and third experiments, the author's original developments, "SQL Escape Room" (28 participants) and the client-server environment "Temple of Data" (31 participants), were approved. Survey studies show high satisfaction and engagement, with over 3/4 of students rating the game-based approach as more effective than the traditional one. Especially valuable are the "Temple of Data" applications for mastering unfamiliar SQL constructs (UNION, INTERSECT, EXCEPT) through practical actions and logical thinking. A positive impression is made by the PhD student's objectivity, who does not conceal the students' recommendations for refining some textual conditions and interface elements.

In the Conclusion, the results achieved in fulfilling the set tasks, the contributions, and perspectives for future research on the topic of the dissertation thesis are summarised.

A list of 8 publications with the participation of the PhD student, evidence of 9 citations of publications, and data on participation in 5 projects funded by the "Scientific Research" Fund at PU and the Ministry of Education and Science (MES) are attached.

The dissertation thesis and the provided materials are very well formatted.

7. Contributions and Significance of the Development for Science and Practice

I accept the scientific, scientific-applied, and applied contributions formulated in the dissertation thesis.

Scientific contributions are expressed in the designed unified conceptual framework for designing intelligent and gamified educational resources, which integrates modern pedagogical approaches, game mechanics, and artificial intelligence technologies. In this direction, the proposed methodology for designing educational resources also stands out, upgrading the principles of adaptive learning and gamification by integrating generative artificial intelligence capabilities. These theoretical propositions enrich scientific knowledge in the field of digital transformation of higher education.

Among the *scientific-applied contributions*, the developed conceptual models for specific educational applications with specific interaction mechanisms and AI components stand out, as well as the creation of a working methodology for their implementation in electronic environments defining clear learning scenarios, feedback, and grading systems. Of distinct value for practice is the design and implementation of the specialised software module (plugin) for the Moodle platform, which solves a problem of integrating external games into established LMS systems.

The *Applied contributions* of the dissertation research are the developed prototypes of intelligent and gamified educational resources created for the "Databases" course, as well as their successful experimental approval in a real university environment. Empirical data confirm the practical applicability and pedagogical effectiveness of the proposed ecosystem.

A positive impression is also made by the outlined perspectives for future development, which demonstrate a long-term vision for the evolution of the proposed models, multiplying the approach in other academic disciplines, and conducting larger-scale studies. All this gives grounds to conclude that the results achieved are significant and have a high potential for implementation in educational practice.

8. Assessment of Publications on the Dissertation Thesis

The results obtained in the dissertation thesis have been sufficiently approved before a specialised scientific audience, with the main ones reflected in the publications of the PhD student. They are presented in 8 peer-reviewed editions, 3 of which are indexed in the world-famous databases SCOPUS and/or Web of Science, with 1 of the publications being in a journal with an impact factor (Q4). The minimum national requirements for acquiring the educational and scientific degree "Doctor" in Professional Field 4.6 are fulfilled – 122 points with a minimum requirement of 80 points.

A good impression is made by the fact that as of July 9, 2026, 9 citations of 4 of the publications on the topic of the dissertation thesis have been noticed. The latter proves the relevance of the dissertation research topic and the significance of the results.

9. Personal Participation of the PhD Student

The scientific results and the dissertation clearly reflect the PhD student's personal contribution and her skills in defining tasks, overcoming research challenges, and drawing reasoned conclusions. I do not doubt the personal contribution of the PhD student in the attached publications.

10. Author's Abstract

The author's abstract, written in Bulgarian and English, is prepared according to the current requirements and correctly reflects the content, main results, and contributions of the dissertation thesis.

11. Critical Remarks and Recommendations

I have no remarks on the formatting of the dissertation, the abstract, and the set of documents.

12. Personal Impressions

I do not know the PhD student personally.

13. Recommendations for Future Use of Dissertation Contributions and Results

I will note that this is one of the rare cases in which a PhD student has graduated ahead of schedule and immediately thereafter started the defence procedure. This fact is a clear testament to the high level of organisation of the PhD student, purposefulness, and serious attitude towards scientific research.

The results obtained have the potential for dissemination and multiplication. In this regard, I fully share the perspectives for the future development of the topic outlined by the PhD student. I recommend that Maria Gorgorova publish the results in journals with an impact factor, as well as

continue her research in the field and participate in prestigious international conferences. This would allow a broader foreign scientific community to become acquainted with her developments and appreciate their value.

CONCLUSION

The dissertation thesis *contains scientific, scientific-applied, and applied results that represent an original contribution to science and meet all the requirements* of the Development of Academic Staff in the Republic of Bulgaria Act, the Regulations for its application, and the corresponding Regulations of PU "Paisii Hilendarski".

The dissertation thesis demonstrates that the PhD student **possesses** in-depth theoretical knowledge and professional skills in the scientific speciality of Informatics, demonstrating qualities and skills for independently conducting scientific research.

In light of the above, I confidently give my *positive assessment* of the conducted research presented by the dissertation thesis, abstract, achieved results, and contributions reviewed above. I *propose to the esteemed scientific jury to award the educational and scientific degree "Doctor" (PhD)* to Maria Metodieva Gorgorova in the Field of Higher Education: 4. Natural Sciences, Mathematics and Informatics, Professional Field 4.6. Informatics and Computer Sciences, Doctoral Program "Informatics".

14.08.2026 г.

Reviewer:

Prof. Dr. Rositsa Doneva