

OPINION

by Assoc. Prof. Stoyan Nikolov Cheresarov, PhD, Plovdiv University “Paisii Hilendarski”, Faculty of Mathematics and Informatics, Department of Software Technologies, member of the scientific jury (Chairman) — Professional Field 4.6. Informatics and Computer Science

on a dissertation submitted for the award of the educational and scientific degree “Doctor” in higher education area 4. Natural Sciences, Mathematics and Informatics, professional field 4.6. Informatics and Computer Science, doctoral programme “Informatics”

Author: Maria Metodieva Gorgorova

Title: “Intelligent Components in E-Learning Environments”

Supervisors: Prof. Stanka Ivanova Hadjikoleva, PhD; Assoc. Prof. Silvia Nikolaeva Gaftandzhieva, PhD

1. General Presentation of the Procedure and the Doctoral Candidate

By Order No. RD 22-1412 of 17.07.2026 of the Rector of Plovdiv University “Paisii Hilendarski” (PU), I was appointed Chairman of the scientific jury to conduct the defense procedure for a dissertation entitled “Intelligent Components in E-Learning Environments,” submitted for the award of the educational and scientific degree “Doctor” in higher education area 4. Natural Sciences, Mathematics and Informatics, professional field 4.6. Informatics and Computer Science, doctoral programme “Informatics.” The author of the dissertation is Maria Metodieva Gorgorova, a full-time doctoral candidate at the Department of Computer Informatics, supervised by Prof. Stanka Ivanova Hadjikoleva, PhD, and Assoc. Prof. Silvia Nikolaeva Gaftandzhieva, PhD, of PU “Paisii Hilendarski.”

The set of materials submitted by Maria Gorgorova complies with Art. 36 (1) of the Regulations for the Development of the Academic Staff of PU. The following documents are included:

1. application for opening a procedure for acquiring the educational and scientific degree “Doctor”;
2. curriculum vitae;
3. opinion of the supervisors on initiating the defense procedure;
4. minutes of the preliminary discussion at the Department of Computer Informatics council, recommending admission to defense;
5. autoreferat (thesis summary) in Bulgarian and English;
6. declaration of originality and authenticity of the dissertation;

7. reference document on fulfilment of the minimum national requirements for acquiring the educational and scientific degree “Doctor”;
8. a list of 8 scientific publications on the topic of the dissertation, 3 of which are published in refereed international journals;
9. a full list of 13 scientific publications;
10. the dissertation, 187 pages in length.

Maria Gorgorova has an active and versatile professional profile. She works as a part-time assistant at PU “Paisii Hilendarski” (since 17.09.2022), where she leads seminars in “Databases,” “Software Technologies 2,” “Software Project Management,” and “Internet Programming with PHP and MySQL,” as well as a part-time assistant at the Academy of Music, Dance and Fine Arts “Prof. A. Diamandiev” – Plovdiv, where she teaches “Interactive Design” (since 2023). From 01.10.2024 to 30.06.2025 she was a researcher at PU on research tasks related to intelligent technologies for the learning process. Since 04.09.2023 she has been a coordinator of the Union of Scientists in Bulgaria, Plovdiv branch, where she organizes scientific conferences and events.

Her bachelor’s degree is in “Software Technologies and Design,” and her master’s degree in “Business Informatics with English,” both from the Faculty of Mathematics and Informatics of PU “Paisii Hilendarski.” She has completed additional specialized training — “Advanced Artificial Intelligence for Education” (Europass Teacher Academy, Dublin, 2025) and the “Digital Qualification” programme (University of Ruse, 2024). She has participated in 7 research and educational projects at the Faculty of Mathematics and Informatics (2021–2026) and in the international “Comenius” labor mobility programme (Poland, 2014). She has received three awards for best scientific paper at national and international scientific forums (2022, 2024, 2025).

This combination of teaching, research, organizational, and publication activity demonstrates a doctoral candidate with an active and consistent scientific career, exceeding the formal requirements for the doctoral degree.

2. Relevance of the Topic

The dissertation addresses a topical problem in the field of informatics and computer science, situated at the intersection of two leading contemporary trends in education — the application of artificial intelligence (AI) and game-based learning (gamification). The starting point of the study is a well-grounded practical problem: the declining motivation and engagement of contemporary learners under traditional teaching methods, combined with a genuine shortage of architectural models and software components for integrating intelligent game-based resources into popular e-learning environments such as Moodle.

The topic is significant both theoretically and practically: on the one hand, a conceptual framework is proposed that unites pedagogical principles, game mechanics, and generative AI technologies; on the other, the framework is implemented as working software and deployed in a real learning process. This directly addresses the need for tools that are accessible to

instructors (without requiring deep technical expertise) for creating interactive learning content, while the integration into a real e-learning environment ensures the direct applicability of the results.

3. Knowledge of the Problem

Maria Gorgorova demonstrates very good knowledge of the field under study. The literature review in Chapter 1 is built on 169 sources, a significant portion of which are recent publications from the 2024–2026 period, evidencing good awareness of the current state of research. The review systematically covers the digitalization of education, a classification of AI tools in education (intelligent tutoring systems, chatbots, natural language processing, adaptive assessment), and the theoretical foundations of gamification (Bloom’s taxonomy, Keller’s ARCS model, Bartle’s player typology, the distinction between “surface” and “deep” gamification), complemented by a concrete overview of existing SQL-teaching games (SQL Murder Mystery, SQL Island, etc.).

Indicative of the candidate’s thorough engagement with the problem is her own empirical study, included in Chapter 1, on the attitudes of 138 PU students toward the use of AI in education — a result published independently (Gorgorova et al., 2025, INFOTEH) and organically integrated into the context of the dissertation. On this basis, a clearly formulated research gap is derived, which logically motivates the aim and tasks of the dissertation.

4. Research Methodology

The chosen methodology corresponds to the nature of the stated tasks, which combine conceptual modeling, software implementation, and empirical evaluation. The methodology for creating educational mini-games through generative AI is developed in five sequential, iteratively repeating stages (requirements definition → generation → testing → refinement → deployment), and the conceptual models of the specific resources (SQL Escape Room, Temple of Data) are formally defined through actors, objects, and interactions. For the integration into the e-learning environment, a mathematical model for evaluating learner performance, a relational data structure, and a REST API specification are also proposed, and the choice between alternative integration approaches (iframe/REST binding versus a dedicated Moodle plugin) is argued with reference to security requirements.

The empirical part comprises four separate studies with real students across two consecutive academic years (2024/2025 and 2025/2026), combining hands-on work with the developed resources, observation, and anonymous surveys. The candidate methodologically correctly and explicitly states the limitations of her samples (26–40 participants per study, voluntary and self-selected participation) and presents the results as indicative rather than statistically significant evidence — this is a conscientious and scientifically sound position, not a shortcoming of the study.

I consider that the chosen methodology creates the necessary prerequisites for achieving the stated aim. My only remark, which relates more to a direction for future development than to a deficiency of the present study, concerns the scope of the empirical validation — larger-

scale and more controlled comparative studies would allow stronger generalizations about the quantitative effect of the developed resources on learning outcomes.

5. Characteristics and Assessment of the Dissertation and Its Contributions

The dissertation is 187 pages long and comprises an introduction, four chapters, a conclusion, and a bibliography (169 sources).

Chapter 1 presents a systematic review of contemporary approaches in education related to digitalization, AI, and gamification, and derives the research gap that motivates the dissertation.

Chapter 2 presents the conceptual models of the study: a methodology for creating educational mini-games with generative AI; conceptual models of the “SQL Escape Room” and “Temple of Data” games; a general model for integrating game-based resources into an e-learning environment, including a mathematical evaluation model, a relational data structure, a REST API specification, and a comparison of alternative approaches for integration with Moodle.

Chapter 3 is dedicated to the software implementation and, in my opinion, constitutes one of the strongest parts of the dissertation. In addition to a developed suite of educational mini-games for Databases (unified into a publicly accessible platform) and the client-server application “Temple of Data” (open-source, with a publicly available demo), the candidate has implemented a fully-fledged Moodle plugin (mod_aigames), integrated with a Google model (Gemini 2.5 Flash) via the Google AI Studio API. The implementation includes mature engineering solutions atypical of prototype software within the scope of a doctoral dissertation: caching of AI responses, rate limiting with a daily quota and a fallback model in case of overload, mechanisms for hiding correct answers from the client, idempotent processing, an implementation of the Privacy API (in compliance with GDPR), and backup/recovery mechanisms. This demonstrates not merely conceptual but genuine, production-level software competence.

Chapter 4 presents the results of four empirical studies (two experiments involving AI functionality in Moodle, and evaluations of the “SQL Escape Room” game and the “Temple of Data” environment), conducted with real students. The results consistently show a high degree of satisfaction, engagement, and willingness to participate again, confirming the practical applicability of the developed solutions.

The contributions of the dissertation, as formulated by the candidate, are as follows:

Scientific contributions: - A conceptual model has been developed for designing intelligent and gamified educational resources, integrating pedagogical approaches, game mechanics, and artificial intelligence technologies into a unified conceptual framework in support of learning. - A methodology has been proposed for designing and developing intelligent educational resources, uniting the principles of gamification, adaptive learning, and the use of generative artificial intelligence in the creation of interactive educational applications.

Scientific-applied contributions: - A suite of intelligent and gamified educational resources for teaching Databases has been developed. - Conceptual models of the individual educational applications have been developed. - A methodology for the deployment and use of the resources in an e-learning environment has been developed. - A module for integrating educational games into Moodle has been developed.

Applied contributions: - Software prototypes of the developed resources have been implemented. - An experimental evaluation has been conducted, confirming their practical applicability and effectiveness.

Taken together, the contributions represent a logically coherent and significant result, combining theoretical modeling, genuine software implementation of production quality, and empirical validation in a real educational context — a combination rarely achieved with this degree of completeness in a dissertation in this field.

6. Assessment of the Publications and the Candidate's Personal Contribution

The candidate's publication activity merits a highly positive assessment. A total of 8 scientific publications on the topic of the dissertation have been published, three of which are indexed in Web of Science and/or SCOPUS (one of them in Web of Science with IF=0.3, Q4). The candidate's full publication list comprises 13 titles. 9 citations of 4 of the dissertation-related publications by other authors have been recorded (2024–2026), evidencing the visibility and recognition of the results within the research community.

The candidate is the lead author of the majority of the publications related to the dissertation, which, combined with the independently developed and publicly accessible software implementation (the Moodle plugin, the open-source “Temple of Data,” and the catalogue of mini-games), convincingly demonstrates her independent personal contribution to the research.

The assessment of the publication activity should be viewed in the context of her broader academic activity as well — an active teaching load at two higher education institutions, participation in 7 research and educational projects, three awards for best scientific paper at national and international conferences, and organizational activity as a coordinator of the Union of Scientists in Bulgaria. Taken together, this demonstrates a doctoral candidate with consistent, multifaceted, and active scholarly engagement.

7. Autoreferat (Thesis Summary)

The autoreferat is 32 pages long, including the bibliography. It accurately reflects the structure, content, and results of the dissertation — the introduction, the four chapters, a conclusion with clearly formulated contributions (scientific, scientific-applied, and applied), and the validation studies. The presentation is terminologically sound, fully corresponds to the content of the dissertation, and allows a correct assessment of the relevance, scientific significance, and practical applicability of the work.

Critical remarks. A close reading of the dissertation and the autoreferat revealed several minor editorial inconsistencies which do not affect the substance of the results achieved, but which should be corrected in the preparation of the final version of the work: a discrepancy between the length of the main text stated in the introduction (“158 pages”) and the actual pagination of the document (187 pages); a typographical error in the title of subsection 3.6.4 (“Модълът „AI Games”” instead of “Модульт”); an inconsistency in the bibliography, where the cited source Putri & Asrori is dated 2019, while the same study is cited in the main text of Chapter 1 as “(Putri & Asrori, 2023)”; and the absence of an explicit explanation as to why the two developed game applications — “Temple of Data” and “SQL Escape Room” — use thematically different training databases (real estate and sales, respectively). These remarks are purely editorial in nature and do not diminish the value of the scientific, scientific-applied, and applied results achieved.

8. Recommendations for the Future Use of the Dissertation’s Contributions and Results

The models and resources developed in the dissertation provide a good basis for further development in several directions: - conducting larger-scale and methodologically more rigorous experimental studies (e.g., with control groups) to quantitatively confirm the positive effect established; - extending the developed intelligent and gamified resources to other academic disciplines beyond Databases; - deepening the adaptive mechanisms and the personalization of learning content through generative AI; - considering a more general, platform-independent integration (e.g., through a standard such as LTI), building on the specialized Moodle plugin implemented, with a view to broader applicability beyond the specific e-learning environment.

CONCLUSION

The dissertation contains scientific, scientific-applied, and applied results that constitute an original contribution to science and meet the requirements of the Act for the Development of the Academic Staff in the Republic of Bulgaria (ADASRB), the Regulations for the Implementation of the ADASRB, and the corresponding Regulations of PU “Paisii Hilendarski.”

The dissertation demonstrates that the doctoral candidate Maria Gorgorova possesses in-depth theoretical knowledge and a high level of professional and engineering competence in professional field 4.6. Informatics and Computer Science, demonstrating the qualities and skills required to conduct independent scientific research — from conceptual modeling, through software implementation of production quality, to empirical validation in a real learning environment.

In view of the above, I confidently give my positive assessment of the research conducted, as presented through the dissertation, the autoreferat, the results achieved, and the contributions made, and I propose to the esteemed scientific jury that the educational and scientific degree “Doctor” be awarded to Maria Gorgorova in higher education area 4. Natural

Sciences, Mathematics and Informatics, professional field 4.6. Informatics and Computer Science, doctoral programme “Informatics.”

26.08.2026 Plovdiv

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