REVIEW

by Prof. Dr. Darinka Nencheva Galabova
Faculty of Mathematics and Informatics
at the University of Veliko Tarnovo "St. Cyril and Methodius"
d.galabova@ts.uni-vt.bg

on a dissertation for the award of the educational and scientific degree "DOCTOR" in:
Field of higher education 1. Pedagogical sciences
Professional field 1.3. Pedagogy of teaching in...
Doctoral program "Methodology of teaching in mathematics"

Author: Penka Georgieva Karadjova

Topic: "Synergetic Aspects of Continuity in Mathematics Education in Secondary School (Grades 5-7)"

Scientific Supervisor: Assoc. Prof. Dr. Dobrinka Vasileva Milusheva-Boykina, Department of Mathematics, Informatics and Information Technologies Education, Faculty of Mathematics and Informatics, Plovdiv University "Paisiy Hilendarski"

1. General description of the submitted materials

By order No. PD-22-395/20.02.2026 of the Rector of Plovdiv University "Paisii Hilendarski" (PU), I have been appointed as a member of the scientific jury in the procedure for the defense of a dissertation on the topic "Synergetic aspects of continuity in mathematics education in secondary school (5th–7th grade)" for the acquisition of the educational and scientific degree "doctor" in the field of higher education 1. Pedagogical sciences; Professional field 1.3. Pedagogy of education in...; Doctoral program "Methodology of education in mathematics". The author of the dissertation is Penka Georgieva Karadjova - a doctoral student in part-time study at the Department of "Education in Mathematics, Informatics and Information Technologies", Faculty of Mathematics and Informatics of Plovdiv University "Paisii Hilendarski".

At the first meeting of the scientific jury (Minutes No. 1 /23.02.2026) I was selected as a reviewer of the dissertation work. This review has been developed in accordance with the Act on the Development of the Academic Staff in the Republic of Bulgaria (ADSRB), the Regulations for the Implementation of the ADSRB and the Regulations for the Development of the Academic Staff at the University of Plovdiv.

I have been provided with a set of materials on an electronic medium for review, which is in accordance with Art. 36. (1) of the Regulations for the Development of the Academic Staff of Plovdiv University (PU). The set includes the following documents:

- Application to the Rector of Plovdiv University for the opening of a procedure for the acquisition of the ONS "Doctor";
- Curriculum vitae in European format;
- Opinion of the scientific supervisor on the readiness for a preliminary discussion of the thesis;
- Minutes of the preliminary discussion in the department, with a proposal from the department to open a procedure for the defense and a report by the head of the department with a proposal for the composition of the scientific jury;
- Dissertation;
- Abstract of the dissertation (in Bulgarian and English);
- List of the doctoral student's publications on the topic of the dissertation;
- Copies of scientific publications on the topic of the dissertation - 5 articles;
- Reference for registered citations of a publication and participation in scientific forums;

• Reference for fulfillment of the minimum national requirements for obtaining the ONS "doctor" in the professional field 1.3. Pedagogy of education...;

• Declaration of originality and authenticity of the attached documents.

2. Brief biographical data about the doctoral student and doctoral studies

Penka Georgieva Karadjova was born in the town of Asenovgrad on 06.03.1979. She completed secondary education (1993–1998) in her hometown at the "St. Knyaz Boris I." Secondary School with a profile of "Mathematics and Informatics with intensive study of English". She has higher education with the following educational and qualification degrees:

• 1998 - 2002: Bachelor of Mathematics, "Paisiy Hilendarski" University, Faculty of Mathematics and Informatics, Plovdiv;

• 2002 - 2004: Master of "Accounting and Control", "St. Cyril and Methodius" University of Technology, Faculty of Economics, Veliko Tarnovo;

• 2017 - 2018: Qualification "Mathematics Teacher", acquired at Plovdiv University (PU) "Paisiy Hilendarski", Faculty of Mathematics and Informatics;

From August 2019 to August 2024, he is studying in the doctoral program "Methodology of Mathematics Education" at the Faculty of Mathematics and Informatics of PU "Paisiy Hilendarski". The topic of the dissertation is "Synergetic Aspects of Continuity in Mathematics Education in Secondary School".

Penka Karadjova's work experience: For the last ten years (2016-2026) she has been a mathematics teacher (Primary School in Asenovgrad; Secondary School in Plovdiv) and a researcher at the Institute of Robotics of the Bulgarian Academy of Sciences, Sofia (2021-2023). Her previous qualifications (manager, accountant, consultant) are in the field of tourism and trade. She has also been a supervisor and team leader in the UK/England. Specifically, from 2002–2026 she has held the following positions:

• 09.2020 - to date, Mathematics Teacher, Secondary School "St. Konstantin-Kiril Philosopher", Plovdiv;

• 12. 2021 - 12. 2023, Researcher at the Institute of Robotics - BAS- Sofia;

• 11. 2016 - 02. 2020, Mathematics Teacher, Petko Karavelov Primary School - Asenovgrad;

• 11. 2013 - 01. 2017, Project and Program Consultant, Association "Center for Culture and Tourism TRAKEIA", Asenovgrad

• 11. 2012 - 10. 2013, Accountant, "Georgi Sivkov OOD", Asenovgrad;

• 05. 2008 - 10. 2012 and 03.2007-10. 2007: Supervisor, New Farm Produce Ltd, Lichfield, Staffordshire, UK / England;

• 10. 2007 - 03. 2008, Accountant, Trakia Plod OOD, Asenovgrad;

• 07. 2006 - 02.2007, Manager, Elegant, Asenovgrad;

• 01. 2006 - 06.2006, Team Leader, Kirkenel Orchards, Ludlow, Shropshire, UK / England;

• 04. 2005 - 09. 2005, Accountant, Radikom OOD, Production – Plovdiv;

• 08.2002 - 03.2005, Accountant, Georgi Sivkov OOD, Asenovgrad.

Additional courses and qualifications: has completed courses at Telerik Software Academy (C# basics; C# for advanced; Object-oriented programming; Component testing with C#. HTML basics; JavaScript basics). Completed courses at SLOT Academy – "Concept of Programming", PHP Syntax, Application Development, Database.

Computer competences and abilities to work with: Office suite (Microsoft Word, Excel, Power Point, etc.), text formatting. Has skills to work in Internet platforms and applications: Google Apps (Google Classroom, Google Forms), etc. Knows and works with programming languages: C#, JavaScript, HTML, PHP. Works with different types of text and graphic editors: Adobe Reader, Adobe Acrobat Pro, PhotoShop, Correl Draw; Skolo.bg electronic platform.

The language competence of the doctoral student is at an expert level of proficiency in English and Russian. Has editing skills and translation skills from/to English. Has organizational and team skills (creativity, initiative, problem solving, responsibility). Is able to effectively

organize the learning process. Has excellent communication, management and administrative skills.

The doctoral student has completed the individual curriculum and has covered the minimum national requirements according to Art. 2b, para. 2 and 3. of the Law on the Education and Training of the Republic of Bulgaria (90 points for dissertation and publications). The readiness of the doctoral student for defense is confirmed in the Opinion of the scientific supervisor dated 07.01.2026. The dissertation work of doctoral student Karadjova has successfully passed the preliminary discussion at a meeting of the department (Minutes No. 24-2025/26/dated 03.02.2026), which was in an extended composition (Prof. Dr. Kosta Garov, Prof. Dr. Todorka Zh.Terzieva). She received positive opinions and a high score, which define the dissertation work as impressive and large-scale in the areas of research (synergetics, psychology, pedagogy, methodology of mathematics education).

The procedure for the training of the doctoral student is in accordance with the Law on the Development of the Academic Staff in the Republic of Bulgaria (Art. 4/ Para. 1; Para. 2.) and the Regulations for its implementation (Art. 2./Para. 1-2; Art. 30/Para. 3; Art. 31/Para. 1), in compliance with the Regulations for the Development of the Academic Staff of the Plovdiv University "Paisiy Hilendarski" (Section IV and V). There are no violations and the defense of the dissertation can proceed.

3. Relevance of the topic and appropriateness of the set goals and objectives

The dissertation is dedicated to a current and significant problem for the theory and practice of mathematics education – ensuring continuity through a synergistic approach in education at the junior high school level. The problem of continuity in mathematics education is particularly sensitive in the transition between grades at the junior high school level (grades 5–7), where the following are observed: fragmentation of knowledge; difficulties in transferring skills; decline in learning motivation; accumulation of gaps in mathematical thinking. In this context, the search for synergistic grounds for optimizing continuity is scientifically justified and practically necessary. The author convincingly argues for the need for a new reading of the problem through the ideas of self-organization, nonlinearity and open educational systems. The topic convincingly fits into the context of the modernization of education, the competency-based approach and the need for integrative pedagogical solutions. The relevance of the dissertation research is reinforced by:

• the orientation towards interdisciplinary and authentic STEM, assuming synergism of the system at different levels of integration;

• focusing on an age-sensitive stage (11–14 years);

• the need for an innovative technological model with practical applicability;

• testing and verification of the model with a three-year pedagogical experiment.

The topic of the dissertation work is in line with contemporary trends for STEM integration of disciplines and constructivist ideas in education, the research approach, self-learning, reflection and self-development of the personality, and meets the needs of increasing the effectiveness of mathematical education through synergistic models of continuity in its various types and forms.

4. Knowledge of the problem *(scope of sources; analytical skills)*

To develop the author's technological model, a significant amount of specialized sources (a total of 144) relevant to the thematic field of the dissertation research were studied. The key concepts of the work are "continuity" and "synergetic approach in education". First, I will note that the study uses the scientific apparatus of synergetics - a theory of self-organization of complex open and nonlinear systems. Created as a scientific direction by the German physicist Hermann Haken (around the 1970s; for physical systems), synergetics began to be applied to the educational system, which is also an open nonlinear system. Synergetics studies the joint action of the elements of the system, the interrelationships and forces (internal and external) that cause it to self-develop and evolve. Secondly, we should note that the doctoral student takes on the difficult task of searching for the synergistic aspects of "continuity" in mathematics education. On the one hand, mathematical education is a subsystem of the macrosystem of education, school and society, and on the other hand – it is a complex system with internal subsystems (mathematical learning content, teaching methodology; learning resources and educational environment; the teacher, the child, the class, parents, etc.) – and each subsystem is complex to describe as a structure and as an

interaction with the others. Therefore, continuity is correctly defined in the dissertation (on p.14) as a complex and interdisciplinary concept, which is why analysis in a didactic, psychological-pedagogical and organizational context is necessary.

I acknowledge the difficulties in finding and analyzing literature on the topic of synergetics in a pedagogical aspect. Synergetics in education in our country is associated with the Russian philosophical school of synergetics of S. Kurdyumov and El. Knyazeva, Budanov, etc. By 2005, synergetic ideas were adapted to mathematics education in our country. This dissertation work for the first time explores the synergistic aspects of continuity in education (defined as a complex/systemic concept). To clarify it, the doctoral student has studied and analyzed 80 sources in Cyrillic (Bulgarian and Russian) and 64 issues in Latin (English), as well as 10 electronic publications with Internet access. This quantitative scope testifies to serious preliminary research activity and a desire for interdisciplinary clarification of the problem. The bibliographic base covers both classical fundamental authors (Platon, Pestalozzi, Comenius, Rousseau, Piaget, Vygotsky, Dewey, Poya), as well as contemporary research in the field of synergetics, constructivism, motivation, continuity, integration and STEM education, which speaks of good orientation in the historical development and current trends in the subject. To clarify the state of the problem, sources from various fields have been studied, such as:

- **Synergetics** as a new scientific theory in the philosophical works of H. Hacken, Moren, Prigogine, Maturana, etc., and the application of synergetics in/for/of education (Knyazeva, Kurdyumov, Budanov, Bushev, Marulevska, Desev, etc.).
- **Psychology and theories of personality development**: classical models of human intellectual development by J. Piaget, J. Bruner; L. Vygotsky (on the zones of development); H. Gardner (multiple intelligence), B. Bloom, etc.;
- **Pedagogy**, on the historical and pedagogical aspects of continuity (Rousseau, Pestalozzi, Comenius, J. Dewey, Slastenin, Bespalko, Clarin, etc.); classifications of continuity and modern STEM requirements for connectivity between disciplines, integration of educational levels and programs, the competencies for solving problems and life situations are studied;
- **Mathematics teaching methodology** (private didactics): The scientific field of mathematics didactics is equally presented in volume, adapting the ideas of synergism, interaction, reflection to mathematical education (S.Grozdev, M.Georgieva, V.Milushev, P.Petrov, D.Galubova, Z.Lalchev, L.Karakasheva, Frenkev, D.Boykina, K.Koleva, etc.).

This scope shows the author's aspiration for theoretical justification of the developed technological model. As a whole, the content of the work is subordinated to a logical line for revealing the main concepts of the study and their interrelationships, leading to the construction and testing of an author's technological model for synergistic continuity in mathematics education. In the theoretical study, concepts of authors from the bibliographic material are consistently presented.

5. Research methodology

The methodology of the dissertation research is built in accordance with the set GOAL - development and testing of a model for implementing continuity through a synergistic approach in mathematics education in the junior high school stage (grades 5–7), for the implementation of which 6 specific tasks have been set (p.10), which should be specified for mathematics education. The research was implemented through a complex of complementary theoretical, empirical and statistical methods. At the theoretical level, the following methods were applied: research and analysis of pedagogical, psychological and methodological literature, analysis and synthesis, comparison, modeling and theoretical generalizations to build the conceptual framework of the research. The empirical part includes observation of the learning process, discussions, group discussions and testing through a developed toolkit of tasks for diagnosing students' knowledge and skills. The main method is the pedagogical experiment, implemented in a real school environment with a control and experimental group and applying the "input - output level" approach to track the dynamics of student achievements. Appropriate statistical methods were used to process, interpret and prove the reliability of the results. The statistical processing is detailed, supported by many tables and diagrams; with a quantitative and qualitative analysis of the results. In constructing and applying the methodology, the author's accumulated personal

pedagogical experience was also used, which contributes to the practical applicability and validity of the study.

6. Characteristics and evaluation of the dissertation work

The dissertation is structured logically and consistently. The volume of the dissertation work is **256 pages**, of which 187 in the main part, containing: introduction, 3 chapters, conclusion, list of publications on the topic of the dissertation, used literature. The three appendices are 69 pages in volume. The literature used includes 144 titles of articles and books, and 10 Internet sources, of which – 80 are in Cyrillic and 64 in Latin. The overall composition testifies to a good knowledge of the requirements for scientific research work of this type. The clear conceptual framework of the study, the correct formulation of the object, subject, goals, tasks, hypothesis and methodology are impressive. The author demonstrates a desire for systematicity and methodological precision. Structurally, the dissertation is logically organized and subordinated to the research goal.

The **first chapter** of the work has a fundamental nature and builds the theoretical framework – a comprehensive theoretical analysis of the basic concepts of synergetics, continuity, reflection and constructivism is made. The development and types of continuity in education (content, methodological, etc.) are analyzed; the normative context in Bulgaria is considered. In 1.1.5. challenges to continuity in STEM disciplines are revealed: problems in intradisciplinary and interdisciplinary continuity. Higher levels of integration of STEM fields can also be studied. Approaches, means and strategies for ensuring continuity (integrated, constructivist, spiral, etc.) are systematized (on p.28).

The author presents the essence of synergetics as a scientific paradigm (1.3/p.32). The experience of pedagogical interpretation of synergetic concepts (open systems, attractors, fluctuations, self-organization) is especially valuable. A theoretical overview of synergetics in pedagogy and training is made (p. 42, on the synergetics of/in/for education; self-reflection, the transforming role of the teacher, etc.) and the essence of synergetics thinking is clarified (p. 60). This shows interdisciplinary culture and theoretical maturity. A strong point of the first chapter is the justification of mathematics education as a nonlinear system and the derivation of the role of the teacher as a phase moderator who creates conditions for self-organization; and as a mediator of synergetic continuity. The second chapter has a clearly expressed applied focus and represents a significant contribution of the dissertation. It analyzes the educational content of mathematics (grades 5–7). The psychological and pedagogical features of the age of students are taken into account and the didactic foundations of the model are formulated. A technological model for synergetic continuity is developed. The model has a modular structure of 6 modules with connections presented in a pie chart (Figure 1/p.105):

1) Continuity of language and symbolism; 2) Strategies for solving problems and developing mathematical thinking; 3) Learning errors, difficulties and adaptive intervention;
4) ICT and digital environments in synergy with mathematical content;
5) Cross-curricular connections (in a STEM context) and contextualization of knowledge;
6) Indicators of effectiveness and reflective assessment of the modules.

The model offers goals, content, stages, principles, methods and expected results. The author's systematizations are presented in 7 tables, of which Table 2, Table 3. Types of tasks (p.93) and integral STEM technologies (tables №5 and №6) very well present the synergistic continuity. The striving for completeness and practical applicability of the proposed technology is impressive. The author's synergistic model is distinguished by:

- conceptual validity and methodological applicability;
- compliance with age-specific characteristics;
- emphasis on working with errors (considered as fluctuations in the learning and self-learning process) and adaptive support for the student;
- integration of ICT and interdisciplinary connections;

The **third chapter** presents the organization and results of a three-year pedagogical experiment (2021-2024). It was conducted with 136 students (6 classes) from the secondary school Sofia University "St. Constantine-Kiril Philosopher", Plovdiv. For the three years, the students were trained sequentially from fifth to seventh grade. The control group (a, b, c classes) and the experimental group (d, e, f classes) are evenly distributed. Scheme 1 (p.140) reveals the

stages of the experiment (determining, formative, control). Criteria and indicators for diagnosing the results of the experiment have been developed (tables No. 9, 10). Research procedures, diagnostic tools and comparative analysis between the input and output levels are described. The main characteristics of the didactic materials have been studied, and the assessments of the quality of the tests are presented in Appendix 3. (p. 226). The data presented show positive dynamics in the achievements of students in the experimental group. The processing of the results is correct and supported by statistical procedures and visualization (diagrams, histograms, tables) and analyses.

Overall, the content of the work follows a clear logical line - from theoretical clarification of the problem to modeling and experimental verification. The bibliography is sufficient and shows a very good awareness of the doctoral student in the areas of synergetics, pedagogy and methodology of mathematics education.

The conclusion summarizes the research work through conclusions and findings. The scientific and applied contributions and the prospects of the study in 7 directions are presented (digitalization, interdisciplinarity, teacher qualification, etc.).

Visualization in the main text is provided by 22 tables and 21 figures (chapters II and III), and 27 tables in the Appendices (№23 - 50).

The Appendices are 69 pages long (p.188 - 256). They present (3.1 and 3.2) the diagnostic tests used in the approbation and their results, analysis of the qualities of the test tasks. Of particular value are the described didactic materials for the formative experiment (Appendix 3.1/p.226-239): project tasks, control and independent work for 5th, 6th, 7th grades, drawing by coordinates (p.247-248), etc.

7. Contributions and significance of the work for science and practice

The scientific and applied contributions formulated by the doctoral student can be considered reliable and justified in their main part. They arise logically from the conducted theoretical research and from the results of the pedagogical experiment. Particularly significant is the contribution related to the development and testing of a technological model for the implementation of synergistic continuity in mathematics education.

The empirical data support the claims for a positive effect of the application of the model, although for greater persuasiveness a wider experimental field and more detailed statistical argumentation of some dependencies would be useful. Despite the noted partial inaccuracies in the quoting technique and repetitions of thematic fields, the presented results and conclusions are sufficiently reliable and correspond to the set goals of the study. The dissertation work contains contributions of a scientific-theoretical and scientific-applied nature, which expand knowledge in the field of mathematics education methodology and create opportunities for improving pedagogical practice. In summary, contributions are accepted in two main groups:

First group. Scientific-theoretical contributions

1) The theory of continuity has been enriched through a synergistic interpretation – a conceptual connection between continuity and self-organization has been deduced. Basic concepts and dependencies related to synergetics, reflection and continuity in mathematics education have been systematized and theoretically understood, and their place in the modern educational paradigm has been clarified.

2) Mathematics education has been justified as an open nonlinear system and the possibility of using the synergistic approach as a methodological basis for ensuring continuity in mathematics education at the junior high school stage has been revealed.

3) The theoretical framework of the reflective-synergistic approach has been expanded and specified by adapting it to mathematics education in grades 5–7.

4) The concept of synergistic thinking, formed as a result of synergistic continuity, has been clarified. Pedagogical conditions and principles for the implementation of synergistic continuity in the mathematics learning process have been derived.

5) Scientific ideas about the role of synergetics as a new educational paradigm in the context of competency-based learning have been supplemented.

Second group. Scientific and applied contributions

6) An author's technological model has been developed to ensure synergistic continuity in mathematics education at the junior high school level, including goals, content, stages, methods and means of implementation. The advantages of the technological model for the thematic core "Numbers. Algebra" have been derived as: "Continuity and smooth transition between classes through spiral development of concepts; Semantic connection between arithmetic and algebraic knowledge; Early formation of functional and relational thinking; Active role of the student in the construction and mastery of knowledge; Synergy between content, methods and learning strategies, leading to sustainable mastery".

7) A diagnostic toolkit (system of criteria, indicators, tasks) has been created to track the dynamics of knowledge, skills and reflective activity of students when solving mathematical problems. The effectiveness of the author's technological model has been proven through testing in a real school environment, which has a positive effect on students' academic achievements and activity.

8) Methodological guidelines and practical recommendations have been proposed for mathematics teachers to apply a synergistic approach in ensuring continuity between classes. The development creates opportunities for implementing the model in school practice and for its use in the preparation and qualification of future and current mathematics teachers.

The dissertation demonstrates very good knowledge of the research problem, consistency in scientific research and a real contribution to the methodology of mathematics education through a synergistic approach. The contributions of the dissertation have real significance both for enriching the theory of mathematics education and for improving pedagogical practice through the implementation of synergistically oriented learning models.

8. Assessment of publications on the dissertation work

In the procedure for acquiring the educational and scientific degree "doctor", Penka Karadjova presents 5 (five) publications on the topic of the dissertation work. Two of the publications are co-authored (with the learned supervisor), and the remaining 3 are authored (1 author). The language of writing in 4 publications is Bulgarian, and 1 publication is in English. The dynamics of publications during the period of doctoral studies proves the rhythm of presenting the results in the scientific space: 2021 (one); 2022 (two); 2024 (one); 2025 (one). Two citations of P. Karadjova's publication "Synergetics in Education as a New Educational Paradigm. 2024" have been registered.

Table 1. Dynamics of publications during the doctoral period (2019 - 2024)

Publications of the doctoral student	Place of publication	Year
1. Karadzhova, P., D. Boykina. (2021). Synergetic Fundamentals of Mathematics Education.	In: Proceedings of the Anniversary International Scientific Conference “REMIA 2021”, 22 – 24 October 2021, ISBN: 978-619-202-711-7	2021
2. Karadzhova, P., D. Boykina. (2022). Synergetic aspects of continuity in education.	In: Science and Education a New Dimension. Pedagogy and Psychology, X (102), Issue: 263, 2022 Febr. https://doi.org/10.31174/SEND-PP2022-263X102-04	2022
3. Karadzhova, P. (2022). Continuity in the use of a synergistic approach in mathematics education when working with text problems.	Student Almanac (9), Faculty of Pedagogy, Thracian University − Stara Zagora, Anniversary International Scientific Conference “Education and Contemporary Challenges”, 24 – 25 June 2022, pp. 16-21, ISSN 2603-3178	2022
4. Karadzhova, P. (2024). Synergetics in education as a new educational paradigm.	In: Tereni (8). Seminar for PhD students and young scientists: Academic trajectories. September 1 – 4, 2023. Rhodope Center, Slaveyno village, Sofia University “St. Kliment Ohridski”, p. 136-145. DOI:10.60053/TER.2024.8.136-145	2024
5. Karadzhova, P. (2025). Technological model for ensuring synergistic continuity in mathematics education.	Jubilee International Scientific Conference "Synergetics and Reflection in Mathematics Education", October 22-24, 2025, Pamporovo. Paisii Hilendarski University of Applied Sciences, pp. 75-82, ISBN: 978-619-7768-41-1.	2025

9. Personal participation of the doctoral student

From the presented dissertation and the abstract, it can be concluded that the study is mainly the result of the doctoral student's independent research activity. The author independently conducted the study and analysis of the scientific literature, the formulation of the conceptual framework, the development of the technological model and the preparation of the diagnostic tools. The organization and conduct of the pedagogical experiment, as well as the processing and interpretation of the results, also testify to active personal participation. Some of the publications are co-authored (2 with the scientific supervisor), which is a common academic practice and does not question the leading role of the doctoral student in the development of the dissertation problem. In general, it can be assumed that the results obtained and the formulated contributions are to a significant extent the personal merit of the author.

10. Abstract

The volume of the abstract is 32 pages (University requirements), which is why the chapters of the work have a laconic content. The following are described: the relevance, purpose, tasks, methodology of the research, main results and contributions of the work. The structure corresponds to the requirements for this type of scientific presentation. A positive impression is made by the clear tracing of the relationship between the theoretical formulation, the author's model and the experimental verification. There is a list of publications on the topic of the dissertation. A list of 65 sources has been adapted for the abstract. The abstract faithfully presents the content and research results, and fulfills its purpose.

11. Critical remarks

• The introduction has redundant numbering, which is typical for the chapters and paragraphs of the work.

• In individual paragraphs (first and second chapters) there is an overlap of semantic fields, which makes the logical line of the exposition difficult to follow. The text is descriptive in nature with an enumerative structure.

• Chapter II. – The author's synergistic 6-module model is described declaratively and enumeratively. The model is universal, with general regulations and claims to be innovative. Therefore, I believe that here in the main text, table No. 50 "Comparison of traditional training and training according to the synergistic technological model", as well as the models of synergistic technologies in mathematics from Appendix 3.1 (p. 226-239), which very well reveal the synergistic aspects of continuity.

• In Chapter III. it is stated that "The didactic resources used support the implementation of the model and contribute to achieving the goals of experimental training." (p.145). I believe that the didactic tools for the formative experiment should be described in a summarized and illustrative manner in the main text (and not in Appendix 3.2 - worksheets, project task, case study, digital resources, etc.), and the appendices should contain additional materials (tests, additional tasks, etc.). In an article by P. Karadjova, there is also a specific methodological development for text tasks that do not find a place in the work.

• Chapter III. – The criteria and indicators formulated by the author measure only the first three levels of "knowledge, understanding, application" (according to Bloom's taxonomy) according to the hypothesis formulated in this way. But it also assumes "... formation of synergetic thinking in students". Naturally, the questions arise: "Why is the higher levels of educational goals (analysis, synthesis, evaluation and creativity) not reached? Is there a criterion for establishing the degree of development of synergetic thinking; what are its components; with what tasks and activities can they be measured?"

• References and citations: Large passages of the text are without references to sources (pp. 22-28; 35-37; 40-42; 45-46, etc.) or the names of the authors are listed. It is not good to cite authors. The analysis of the bibliography shows 50% (25 sources) of methods from Plovdiv University. It is recommended to expand the local environment of research searches.

The above notes do not significantly reduce the scientific value of the work, but would contribute to its further enrichment and improvement. They confirm the complexity of the dissertation research problem and the multitude of concepts, approaches, principles, structures and technologies that must be explored and combined into a single whole.

12. Questions for the dissertation candidate

1) Which fluctuations, in your opinion, most strongly push the system of mathematics education towards evolution? (indicate at least 1 internal and 1 external fluctuation)

2) Was the "didactic game in mathematics" method used in the experiment in a synergistic aspect? If "YES", suggest a game with complication in three series, for grades 5, 6 and 7 respectively?

13. Personal impressions

I do not personally know the doctoral student Penka Karadjova. My impressions are formed from the analysis of the materials provided for review. They give me reason to build a positive attitude towards the doctoral student and to appreciate his highly complex competencies in the intersecting fields of synergetics, pedagogy, psychology, mathematics and the methodology of mathematics education. I admire the results achieved in the dissertation work and the author's articles, one of which has 2 citations.

14. Recommendations for future use of the dissertation contributions and results

The author's modular model can be adapted and tested in other educational stages (for example, primary or secondary school). It could be enriched with models of:

– the structure of tasks/theorems and their solution/proof;

– systems of tasks by complexity through component tasks;

– the logical structure of cognitive mathematical activity (Papp and Euclid schemes; heuristic models for supporting guesswork/insight and creativity; analogy and intuition in mathematics, etc.);

– synergy of educational content (new educational modules; STEAM programs);

– synergetic educational technologies (didactic scenarios of interdisciplinary, integrated and creative lessons; projects with presentation materials and reflection on the process and results; 4K synergistic model of STEAM; series of didactic games in mathematics for grades 5-7, etc.).

Project-based learning (mentioned on p. 50-51) in a contemporary context should be linked to authentic STE(A)M. To explore the role of the holistic approach and the Gestalt approach in the synergistic concept of building a unified picture of knowledge and forming a complete student personality. The researcher's publication activity should be oriented towards scientific publications, referenced and indexed in world-renowned databases of scientific information.

CONCLUSION

The dissertation meets the requirements of the Act on the Development of Academic Staff in the Republic of Bulgaria (ADSRB), the Regulations for the Implementation of the ADSRB and the Regulations for the Development of Academic Staff at the University of Plovdiv. The dissertation contains scientific-theoretical and practical-applied results that enrich the science of Mathematics Teaching Methodology (in secondary school).

The dissertation shows that its author has studied a significant amount of available specialized literature on synergetics, the synergistic approach and synergistic continuity in mathematics teaching. Demonstrates skills for theoretical analysis and synthesis, possesses pedagogical-psychological knowledge, mathematical and methodological competence necessary for the scientific field of Mathematics Teaching Methodology. The theoretical research conducted, the developed technological modular model and its testing through a pedagogical experiment with a large sample and the research results reflected in 5 publications show that Penka Karadjova has the knowledge and skills to independently conduct scientific pedagogical research.

In view of the above, I confidently give my positive assessment of the conducted research and the achieved results and contributions in the dissertation work. I propose to the esteemed scientific jury to award the educational and scientific degree "doctor" to Penka Karadjova in the field of higher education 1. Pedagogical Sciences, professional field 1.3. Pedagogy of Teaching in... , doctoral program Methodology of Teaching in Mathematics.

20.03. 2026 Reviewer: ...../signature/
Veliko Tarnovo (prof. dr. Darinka Galabova)