

REVIEW

by Prof. Dr. Ivaylo Peev Staribratov

University of Plovdiv "Paisii Hilendarski"
Faculty of Mathematics and Informatics
Department of "Education in Mathematics,
Informatics and Information Technologies"

of the materials submitted for participation in the procedure
for awarding the educational and scientific degree "Doctor"

in the field of higher education: 1. Pedagogical Sciences,
professional field: 1.3. Pedagogy of Teaching in ...
doctoral program: Methodology of Teaching Mathematics

Author: Penka Georgieva Karadjova

**Topic: Synergetic Aspects of Continuity in Teaching Mathematics in
Secondary School (5th – 7th Grade)**

**Scientific Supervisor: Assoc. Prof. Dr. Dobrinka Vasileva Milusheva-
Boykina**

1. General Description of the Submitted Materials

By Order No. PD-22-395 of 20.02.2026 of the Rector of University of Plovdiv "Paisii Hilendarski" (PU), I was appointed as a member of the scientific jury for conducting a procedure for defence of the dissertation entitled: "Synergetic Aspects of Continuity in Teaching Mathematics 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 Management: 1.3. Pedagogy of Teaching in ..., doctoral program: Methodology of Teaching in Mathematics. The author of the dissertation is Penka Georgieva Karadjova - a part-time doctoral student at the Department of "Teaching in Mathematics, Informatics and Information Technologies" /TMIIT/, with scientific supervisor Assoc. Prof. Dr. Dobrinka Vasileva Milusheva-Boykina from PU "Paisii Hilendarski", Faculty of Mathematics and

Informatics /FMI/, TMIIT. The scientific jury was approved by the Faculty Council of the Faculty of Mathematics and Informatics at PU with protocol No. 27/18.02.2026.

The set of materials on paper and electronic media presented by Penka Karadjova is in accordance with Art. 36. (1) of the Regulations for the Development of the Academic Staff of PU, includes the following documents:

- application to the Rector of PU for initiation of the procedure for defense of a the dissertation;
- curriculum vitae;
- protocol from the preliminary discussion in the department;
- opinion of the scientific supervisor, reporting readiness to open the procedure and containing a preliminary discussion of the dissertation;
- report of the head of the department;
- abstract in Bulgarian and English;
- declaration of originality and authenticity of the attached documents;
- certificate of compliance with the minimum national requirements;
- list of scientific publications on the topic of the dissertation;
- dissertation work;
- copies of scientific publications related to the dissertation;
- declaration of originality of the results and contributions.

The sets of attached documents are provided in three copies each, both on paper and in electronic form.

The Ph D student has attached five publications on the topic of the dissertation work.

The documents required for the procedure for awarding the scientific and educational degree "Doctor" are presented correctly and are in accordance with the Regulations of the University of Plovdiv on academic staff.

2. Brief biographical data about the doctoral student

Penka Karadjova graduated with a Bachelor's degree in Mathematics from the University of Plovdiv "Paisii Hilendarski", after which she successively obtained a Master's degree in Accounting and Control and a Master's degree in Teaching in Mathematics. In addition to her work as a teacher of mathematics, she has also worked as an accountant, project manager and researcher. From her work biography, it can be said that Penka has acquired rich life and professional experience. At the same time, her sustained interest in mathematics, from secondary education through to doctoral studies, on which she is actively working on, is clearly evident.

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

The topic of continuity in mathematics education is not new, but there is still insufficient research carried out in the light of contemporary theoretical paradigms such as synergeticism. There is a need for research on innovative models that take into account both the cognitive and age-specific characteristics of students, as well as the internal logic of mathematical knowledge. The traditional approach to learning content often proves ineffective, as it does not create networks of knowledge, connections between concepts and meaningful application of what has been learned. Hence arises the need to explore the potential of a synergistic model as a basis for ensuring continuity in mathematics education, both in the lower secondary stage studied by Penka Karadzova and in the overall system.

The lower secondary stage of education is key within the system of mathematics education due to the specific cognitive, content-related and methodological characteristics of this period. It is in it that the transition from concrete-operational to formal-logical thinking, from arithmetic to algebraic and functional thinking, as well as from intuitive learning of knowledge to the conscious construction of abstract mathematical structures is realized. This is the stage in which sustainable learning strategies, metacognitive skills and attitudes towards mathematics are formed, which

determine the further development of students, Therefore, the continuity in mathematics education here is both the most vulnerable and the most significant, and the study convincingly demonstrates its necessity and relevance.

A strong argument for the correct choice of the topic and methodology is its alignment with the established stages in school education (1st - 4th, 5th - 7th and 8th - 12th grades), which allows tracking of the development of the same students within the entire educational stage and guarantees methodological stability of the studied sample, without the influence of class reorganisation or changing schools by the students. This is exactly what the doctoral student has achieved for the stage 5th - 7th grades stage, with a complete and long-term tracking of the development of students within the implemented methodology.

4. Knowledge of the problem

Ph D student Penka Karadjova knows the problem well and has skillfully carried out the research. Her pedagogical experience is sufficient for us to conclude that she has in depth understanding of issues under study. The author demonstrates excellent knowledge of the scientific literature – 144 sources are used, both in Cyrillic and Latin. A systematic theoretical analysis of the concept of “continuity” and its synergistic interpretations is presented. The substantial number of literature sources studied gives reason to conclude that the problem is thoroughly explored.

The bibliographic apparatus is up to date and relevant to the issues investigated.

5. Research methodology

The following theoretical, empirical and statistical methods were used:

- Study and analysis of pedagogical, psychological, methodological literature and educational documentation related to the issues of this study, aimed at building its theoretical.

- Observation of the learning process, comparison, analysis, synthesis, modeling, theoretical summaries, group discussions and interviews.
- Use of accumulated personal experience in teaching mathematics, as well as in teaching with the application of a synergistic approach to implement continuity at the junior high school stage.
- Use of an assessment toolkit, including a system of tasks for testing students' knowledge and skills.
- Pedagogical experiment.
- Statistical methods for data processing and analysis.

The study is based on an interdisciplinary approach, combining pedagogical, psychological and synergistic theoretical foundations. The methodological framework includes:

- The principles of systematicity, continuity and purposeful organization of training.
- The concept of learning as a nonlinear, self-organizing system.
- The interaction model of learning, including activity, motivation and reflection.

The methodology comprises theoretical analysis, construction of a technological model and a pedagogical experiment with a control and experimental group. Clear criteria and indicators for diagnosis are presented. The data from the three-year experiment show a statistically significant increase in the results in the experimental group (Mean EG = 49.51) compared to the control group (Mean KG = 33.88), with Cohen's $d = 0.99$, which confirms the working hypothesis.

The longitudinal comparative analysis by cognitive levels gives additional weight to the methodology and confirms the validity and reliability of the conclusions.

The chosen methodology is suitable for conducting the experiment and an opportunity to make a reliable analysis of the results. The statistics procedures used are described in detail and are well-founded, accompanied by correct conclusions from it.

6. Characteristics and evaluation of the dissertation work

The dissertation work consists of 256 pages, of which 178 on its main part, containing: Introduction, 3 chapters (theoretical, practical-applied, empirical and analytical), Conclusion, Main contributions and recommendations, literature and three appendices. The literature used includes 144 titles of articles and books and 10 Internet sources. The cited articles and books are 80 in Cyrillic and 64 in Latin. The list of author's publications on the dissertation consists of 5 titles, with two citations of these publications recorded.

In the Introduction, the author presents the relevance of the problem, the object and subject subject of the study, its aim, tasks, hypothesis, research methods and the structure of the dissertation.

Chapter I presents an analysis of the conceptual apparatus and the possibility of integrating the synergistic approach in mathematics education at the junior high school stage; The current trends in mathematics education, continuity factors, cognitive development models and the role of ICT, cross-curricular connections are presented.

Chapter II outlines the theoretical and applied framework of the technological model for mathematics education aimed at ensuring continuity through the use of a synergistic approach in grades 5-7 and describes the constructed technological model, which structures the learning process through clearly defined modules: language and symbolism, problem-solving strategies, working with errors, digital technologies and STEM context.

Chapter III presents the conducted experiment and its methodology, carried out in a real school environment with an equivalent control and experimental group. Criteria and indicators for diagnosing the results of the pedagogical experiment have been developed. Two complementary experimental methods have been applied - "control group - experimental group" and "input-output level" and the results have

been analyzed. This gives an even higher value to the study. Statistical processing of the results of the conducted experimental work is presented. A thorough comparative analysis of the obtained results is made. Relevant conclusions and generalizations are formulated.

The appendices present the diagnostic tests used, their results and didactic materials.

The work as a whole is structured in a classical academic style. It is written in good scientific language and is characterized by a high degree of reliability, as the information obtained from the statistical processing of the results of the study is skillfully used and analyzed. There is no doubt regarding the credibility of the conclusions, and there is absolutely no indication of plagiarism.

The dissertation is the result of substantial personal effort and work on the implementation of the study, and the contributions indicated in it are indisputable.

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

The hypothesis, aim and tasks of the dissertation research have been fulfilled. The main contributions are classified as scientific-applied and practical-applied.

Scientific-applied contributions are:

1. An analysis of the theoretical foundations of the concept of "continuity" in the context of the synergistic approach and the importance of continuity for mathematics education is justified.
2. A technological model for mathematics education at the lower secondary school has been developed and implemented.
3. In-depth analyses of the curriculum content and some methodological features of teaching in grades 5–7 have been performed from perspective of continuity and its current state has been diagnosed. The possibilities for applying a synergistic approach in a pedagogical context have been studied.

Practical-applied contributions:

1. A didactic model has been constructed and tested in a real school environment.
2. A didactic toolkit has been developed, including six modules and a system of criteria and indicators for diagnosis.
3. An analysis of the results of the experiment has been carried out and relevant conclusions and recommendations for practice have been formulated.
4. Methodological guidelines for the teacher have been developed, encouraging targeted use of the synergistic approach in planning, conducting and analyzing learning situations.

The contributions have a clearly expressed scientific and practical applicability.

8. Assessment of the publications on the dissertation work

All five presented publications are devoted to the topic of the dissertation. Two of them are co-authored with the scientific supervisor, which shows that during the first two years of work the doctoral student was also trained in the methods of writing scientific article. The other three publications are single-authored, one of them being in English. The impact of the research would be even greater if all publications were freely accessible and written in English.

The articles present the results of the experiments conducted in connection with the dissertation.

9. Personal contribution of the doctoral student

The development of the tests, as well as the statistical processing of the obtained results, are the personal contribution of the doctoral student. The self-assessment of the scientific-applied and applied contributions is well formulated and is confirmed by the structure and content of the dissertation. The long-term research conducted

demonstrates both the responsible execution of the study and contributes to its completeness.

10. Abstract

The abstract is 32 pages long and includes all the main components contained in the dissertation. None of the important conclusions from the conducted research have been shortened. The theoretical part and the tables and figures have been shortened. The bibliography includes 26 sources, 13 of which are in English. Both noted citations of one of the author's articles are included. A table has been attached showing the links between the contributions, the research tasks, their place of description in the dissertation and the publications.

11. Critical remarks and recommendations

1. The comparative analysis could be expanded by including international models of continuity. Incorporating broader international experience would add further scientific depth to the otherwise very good dissertation.
2. Increased publication activity in refereed and indexed journals would provide greater visibility to the researched problem.

The above remarks are constructive in nature and do not diminish the scientific value of the work.

12. Personal impressions

From the brief meetings, during the pre-defense, I formed the impression that Penka Karadjova is a highly motivated lecturer with clear goals for scientific development and professional growth.

13. Recommendations for future use of the dissertation's contributions and results

I recommend that Penka Karadjova continue the development of the topic in the educational stage, covering grades 8-10, and, with her enthusiasm and already established research and publication skills, further expand these studies.

Where possible, the results of the research should be shared with a wide circle of colleagues.

CONCLUSION

The dissertation contains scientific-applied and applied results that represent an original contribution to science and meet all the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (LAADRB), the Regulations for the Implementation of LAADRB and the relevant Regulations of University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the Ph D student Penka Georgieva Karadjova possesses in-depth theoretical knowledge and professional skills in the scientific specialty "Methodology of Mathematics Education", demonstrating qualities and skills for independent conduct of scientific research.

In view of the above, I confidently give my **positive assessment** of the conducted research, presented in the dissertation, abstract, obtained results and contributions, and I **propose** to the esteemed scientific jury **to award the educational and scientific degree "Doctor"** to Penka Georgieva Karadjova in the field of higher education 1. Pedagogical Science; professional field 1.3 Pedagogy of Teaching in ...; doctoral program Methodology of Teaching Mathematics.

20.03.2026

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PROF. IVAYLO STARIBRATOV, PhD