

OPINION

by **Prof. Zdravko Vutov Lalchev, PhD**, Sofia University "St. Kliment Ohridski"

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 Education in ...,
doctoral program Methodology of Mathematics Education

Author: Penka Georgieva Karadjova

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

Scientific Supervisor: Assoc. Prof. Dobrinka Vasileva Milusheva-Boykina, PhD, Plovdiv University "Paisiy Hilendarski"

1. General description of the submitted materials

By order № PD-22-395 of 20.02.2026 of the rector of Plovdiv University "Paisiy Hilendarski", I am appointed as a member of the scientific jury for ensuring a 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: field of higher education 1. Pedagogical Sciences, professional field 1.3. Pedagogy of Education..., doctoral program Methodology of Mathematics Education.

The author of the dissertation is Penka Georgieva Karadjova - a part-time doctoral student at the Department of Education in Mathematics, Informatics and Information Technologies, with scientific supervisor Assoc. Prof. Dobrinka Vasileva Milusheva-Boykina, PhD, Plovdiv University "Paisiy Hilendarski"

The set of materials presented by Penka Karadjova on electronic media is in accordance with Art. 36. (1) of the Regulations for the Development of the Academic Staff of the University of Plovdiv, and includes the following documents: a request to the Rector of the University of Plovdiv to open a procedure for the defense of a dissertation; a CV in European format; a protocol from the departmental council related to reporting the readiness to open a procedure and to a preliminary discussion of the dissertation; dissertation; abstract; list of scientific publications on the topic of the dissertation; copies of scientific publications; list of registered citations; declaration of originality and authenticity of the attached documents; certificate of compliance with the national minimum requirements for the acquisition of educational and scientific degree "Doctor"; publications on the topic of the dissertation.

2. Brief biographical data of the candidate

Penka Karadjova was born in the town of Asenovgrad. In 1998 she graduated from secondary school with a profile: Mathematics and Informatics with intensive study of English. In 2002 she graduated from the Bachelor's program at the Faculty of Mathematics and Informatics of the Plovdiv University "Paisiy Hilendarski", majoring in Mathematics. In 2024 she graduated from the Master's program at the Faculty of Economics of the Veliko Tarnovo University "St. Cyril and Methodius", majoring in Accounting and Control. In 2018, she acquired the classification "Mathematics Teacher" at the Faculty of Mathematics and Informatics of the Plovdiv University "Paisiy Hilendarski". From 2019 to the present, she has been pursuing a doctoral program in Mathematics Teaching Methods at the Faculty of Mathematics and Informatics of the Plovdiv University. She has worked as an accountant, as a manager, team leader and supervisor (in England), as a consultant on projects and programs, as a researcher at the Bulgarian Academy of Sciences and since 2016 she has been a teacher in Mathematics. Penka Karadjova has excellent computer skills and competencies – office suite, text formatting, working on the Internet, programming languages, working with various text and graphic editors. She also has excellent organizational skills – creative thinking, initiative, problem solving, sense of responsibility, effective organization of the educational process, precise work, teamwork skills. Has expert level English and Russian and possesses excellent editorial skills in Bulgarian and English, which is also evident from the editing of the dissertation.

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

The main task of the junior high school stage in mathematics education is to realize a transition in the mathematical thinking of students from a practical-inductive to a theoretical-deductive level. It is no coincidence that during this transition a number of didactic difficulties arise related to continuity. Since the traditional approach does not always provide optimal results, it is natural to seek new solutions to the problems related to continuity. In this paper, we find an original idea for studying continuity in mathematics education at the junior high school level from a synergistic perspective, which takes into account not only the linearity of knowledge, but also the complex interactions between students, content, learning environment and teacher competence in the study of mathematics. For this reason, continuity in the junior high school stage is a major subject of research in the methodology of mathematics education.

4. Knowledge of the problem

Pedagogical practice, on the one hand, and careful study and analysis of a large volume and content of bibliographic literature on the other hand, allow the candidate to become deeply familiar with the problem of continuity in mathematics at the junior high school stage. The thorough knowledge of the methodological problem and the in-depth study of the synergistic approach enable the doctoral student to seek and propose an unconventional solution through the tools of synergy in the educational sphere.

5. Research methodology

The chosen research methodology allows achieving the set goal and obtaining an adequate answer to the tasks solved in the dissertation work

6. Characteristics and evaluation of the dissertation work

The dissertation work consists of 256 pages, of which 178 in its main part, containing: Introduction, chapters (theoretical, practical-applied, empirical and analytical), Conclusion, Main contributions and Recommendations, 9 pages of used literature and 3 Appendices in the amount of 69 pages. The used literature 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 publications on the dissertation consists of 5 titles. The publications are cited 2 times.

The introduction presents the relevance of the problem, the object, the subject, the goals, the tasks, the hypothesis, the research methods and the structure of the dissertation.

In Chapter I. Theoretical foundations of the research problem, a systematic theoretical analysis of the concept of continuity in education and possibilities for integration of the synergistic approach in mathematics education at the junior high school stage is presented. Contemporary trends in mathematics education, continuity factors, cognitive development models and the role of ICT, cross-curricular connections and contextualization are presented. This chapter also examines the essence of synergy and its relationship with self-organization in education. The leading idea is to reveal possibilities for applying elements of synergy in mathematics education and, in particular, for realizing effective continuity. At the end of the first chapter, important conclusions are made related to continuity in mathematics education, the synergetic paradigm and the possibilities for interpreting continuity through the principles of synergy as "a naturally occurring connection between previous and new knowledge, determined not only by logical consistency, but also by internal cognitive necessity, network interconnectedness and contextual relevance."

The learning process unfolds through phases of transition and stabilization, the fluctuations in which activate mechanisms of self-organization. The teacher acts as a mediator who maintains a dynamic equilibrium and creates conditions for

the emergence of learning structures. The learning content allows for a synergistic reading through the prism of central ideas or conceptual nodes around which mathematical knowledge is structured. The synesthetic approach provides a toolkit for designing a learning environment and building continuity through internal development, rather than through external pressure or formal transition.

Chapter II. Technological model and approaches for implementation in pedagogical practice outlines the theoretical and applied framework of the technological model for teaching mathematics for implementing continuity in the use of a synergistic approach in grades 5-7. The constructed technological model is presented, structuring the learning process through clearly defined modules: language and symbolism, problem-solving strategies, working with errors, digital technologies and STEM context.

The components of the proposed model are target, content, process, diagnostic, reflexive, organizational and motivational. It is emphasized that each of these components interacts with the others, forming a dynamic system capable of adapting to the specific conditions of learning, the characteristics of students and the specificity of mathematical content. At the end of this chapter, significant conclusions are made, which emphasize the need to integrate the psychological and pedagogical characteristics of students such as cognitive instability, the transition from concrete to abstract thinking, the search for meaning and motivation as a leading factor in learning.

The use of a wide range of didactic tools – from classical to digital, depending on the objectives – also contributes to achieving a synergistic effect. It is emphasized that the modular approach provides an effective framework for synergistic applications in mathematics education. Last but not least, it is emphasized that the synergy between methods, content, technologies and the teacher-student and student-student dynamics is a key factor for the success of the model.

In Chapter III. Organization and implementation of the empirical study. Results of the pedagogical experiment, the organization and methodology of the pedagogical experiment, conducted in a real school environment with an equal control and experimental group, is presented. 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. The experiment was conducted over a period of three years. The presentation in the third chapter shows that the application of the synergistic model, based on a modular structure and methodological integrity, is an effective approach to improving the quality of mathematics education in the lower secondary school

stage. The Appendix presents the diagnostic tests used, their results and didactic materials.

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

Scientific and applied contributions of the dissertation research are: A theoretical basis for the concept of "continuity" has been built in the context of the synergetic approach and the importance of continuity for mathematics education has been substantiated. A technological model has been developed and applied to mathematics education in the lower secondary school stage. The educational content and teaching methodology in grades 5-7 have been analyzed in terms of continuity and its real state has been diagnosed. The possibilities for applying a synergetic approach in a pedagogical context have been studied.

Practical and applied contributions of the dissertation research are: The constructed didactic model has been successfully tested in a real school environment. A didactic toolkit has been developed, including six modules and a system of criteria and indicators for diagnosis. Based on analysis and statistical processing of the results of the experiment, the hypothesis of the dissertation work has been confirmed and relevant conclusions and recommendations for practice have been formulated. Methodological guidelines for the teacher have been developed, encouraging targeted use of the synergistic approach in planning, conducting and analyzing learning situations.

8. Evaluation of publications on the dissertation work

On the topic of the dissertation, 5 articles have been published – 4 in Bulgarian and one in English. Two of the publications have been reported at international and two – at national conferences. One of the articles was cited in two reports of the Jubilee International Scientific Conference “Synergy and Reflection in Mathematics Education”, held in October 2025 in Pamporovo. The publications can also be considered as successful approbations of the ideas from the dissertation research.

9. Personal participation of the candidate

I can confidently say that the dissertation research conducted is the result of the personal participation of the candidate and the results obtained are her personal merit.

10. Abstract

The abstract is short (32 pages), following the traditional structure. It presents the motives, purpose, object, subject, hypothesis, methods of the research. It also briefly presents the content of the dissertation work and the results of the conducted didactic experiment. It also makes recommendations for future research on this topic, an author's reference for the author's contributions and publications

on the topic of the dissertation. The abstract reflects the main results achieved in the dissertation research truthfully and accurately.

11. Critical remarks and recommendations

I have no critical remarks about the conducted research and the set of materials. The research was conducted flawlessly, the theoretical statements are very well argued, the experiment confirms the hypothesis and the statistical analysis of the results of the experiment was done precisely.

CONCLUSION

The dissertation contains scientific, scientific-applied and applied results that represent an original contribution to science and meet all the requirements of 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 relevant Regulations of the Paisii Hilendarski University.

The dissertation shows that the doctoral student **Penka Georgieva Karadjova** possesses in-depth theoretical knowledge and professional skills in the scientific specialty of mathematics teaching methodology, 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 by the above-reviewed dissertation, abstract, achieved 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 Sciences, professional field 1.3. Teaching Methods in ..., doctoral program Teaching Methods in Mathematics.**

03/20/2026
Sofia

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