# R E V I E W

**by Prof. Todorka Zhivkova Terzieva, PhD**

**FMI in University of Plovdiv "Paisii Hilendarski"**

of a dissertation thesis for obtaining the Educational and Scientific degree "Doctor"

in the Area of Higher education **1. Pedagogical sciences**

Professional field **1.3. Pedagogy of teaching in….**

Doctoral program **Methodology of teaching Mathematics**

**Author: Radka Todorova Zlatanova,** a part-time doctoral candidate

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**Topic:** "Formation of creative thinking in students in teaching geometry using dynamic geometric software"

**Scientific supervisor:** Assoc. Prof. Ivailo Peev Staribratov, PhD, University of Plovdiv "Paisii Hilendarski"

## 1. General description of the presented materials

By order № P33-5349 of 22.10.2021 of the Rector of the University of Plovdiv "Paisii Hilendarski", I was appointed as a member of the Scientific Jury for a public defense procedure of a dissertation on the topic **"Formation of creative thinking in students in teaching geometry using dynamic geometric software"** for obtaining the educational and scientific degree "doctor" in the field of Higher education 1. *Pedagogical sciences*; Professional Area 1.3 *Pedagogy of teaching in…*, Doctoral program *Methodology of teaching Mathematics*. The author of the dissertation is Radka Todorova Zlatanova – PhD student in part-time form at the Department of Teaching in Mathematics, Informatics and Information Technologies of FMI, with supervisor Assoc. Prof. Ivaylo Peev Staribratov, PhD from University of Plovdiv "Paisii Hilendarski", Plovdiv. At the first meeting of the scientific jury I was chosen as a reviewer of the dissertation thrsis, according to the protocol № 1/26.10.2021.

The set of materials on electronic media, presented by Radka Todorova Zlatanova is in accordance with the relevant law Art. 36 (1) of the Regulations for Development of the Academic Staff of University of Plovdiv (RDASPU). They are as follows:

1. An Application to the Rector of PU for the disclosure of the procedure for the defense of the dissertation;
2. CV in European format;
3. Protocol №15-2021/2022, 14.09.2021 of the Departmental Council (from the preliminary discussion of the dissertation);
4. Protocol №16-2021/2022, 18.09.2021 (proposal for a jury and date);
5. Abstract;

   5.1. in Bulgarian;

   5.2. in English;
6. Declaration for originality and reliability of the attached documents;
7. Reference for the of compliance with minimum national requirements;
8. List of scientific publications on the topic of the dissertation;
9. List of observed citations;
10. Dissertation thesis;
11. Copies of the publications on the dissertation topic;
12. Certificate №16199/5 November 2015, Series TRU-2015 for II PCS;
13. Set of documents on electronic media from items 1-12.

The documents submitted are precisely formatted and arranged in accordance with the attached list. The doctoral candidate has attached 6 publications on the topic of the dissertation.

## 2. Brief biographical data about the PhD student

Radka Zlatanova finished her secondary education at the Professional High School in Mechanical Engineering „Bratja Evlogy and Hristo Georgievi", Karlovo in 1991 and has a qualification „Technician" in the specialty "Electrical equipment of industrial enterprises". In 1996 she graduated with a Master's degree in Mathematics and Informatics from the Faculty of Mathematics and Informatics at University of Plovdiv "Paisii Hilendarski" and obtained the qualification of "Teacher of Mathematics and Informatics". In 2001 she defended her fifth professional-qualification degree at the Department of Information and Teacher Improvement at Sofia University "St. Climent Ohridski" and in 2003 she obtained her fourth professional-qualification degree at the Department for Information and Improvement of Teachers at the Trakia University, Stara Zagora. In 2013, Radka Zlatanova acquired a third professional-qualification degree at the Department for Information and Improvement of Teachers at Sofia University "St. Climent Ohridski", and in 2015, a second professional-qualification degree at the Department for Information and Improvement of Teacher Qualification at the Trakia University, Stara Zagora. In 2013, she completed a one-year professional-pedagogical specialization "Person-centered education" at the Department of Information and Teacher Improvement at Sofia University "St. Climent Ohridski".

In the period 1996-2007 Radka Zlatanova is a teacher of Mathematics, Informatics and Information Technologies at the Secondary School "Hristo Prodanov" in Karlovo. From September 2007 to August 2016 she is Assistant Director of Educational Activities at the same school. Since 2016 she has been a mathematics teacher in the Mathematical High School "Acad. Cyril Popov" – Plovdiv. Her professional activity is related to planning, preparation and teaching of the mathematics curriculum to VIII – XII grade students, as well as preparing students for participation in competitions and Olympiads in Mathematics. The subject of her work and scientific interests are: stimulating the process of development of the cognitive abilities of students, providing the necessary level for the permanent acquisition of knowledge in mathematics, helping students for their professional orientation, etc.

On 1.03.2020 she has enrolled in a part-time PhD program at the Department of "Teaching in Mathematics, Informatics and Information Technologies", Doctoral program "Methodology of teaching Mathematics".

Doctoral student Radka Zlatanova has excellent communication skills, is fluent in English and Russian. She has been a member of SMB since 1997, chairman of SMB – Karlovo section from 2004 to 2013. She participates in the 13th International Annual Assembly of the Association "Kangaroo Without Borders", regularly participates in trainings and scientific-applied conferences.

### 3. Relevance of the topic and expediency of the set goals and objectives

The use of educational digital environments is becoming increasingly important in modern education. Interactive dynamic environments are among the new challenges for teachers to increase student activity and motivation. The development of students' cognitive motivation is influenced by a variety of factors, and the application of dynamic software in mathematics education provides opportunities for learning through experimentation, for activating learners through trial hands-on activities and exploratory approaches. On the other hand, dynamic environments support the implementation of pedagogical strategies to develop students' thinking.

The dissertation developed by Radka Zlatanova is related to a topical problem for education – the formation of creative thinking in students in geometry education through the application of dynamic geometry software (DGS). The aims and objectives of the research, the object, the subject and the main hypothesis of the research are well defined in the introduction. The main objectives of the present dissertation are the following: development of a methodological tools and technology for teaching geometry using DGS; realization of a pedagogical experiment for diagnostics of the results of training on the topic "Intersection of a polyhedron with a plane". Five tasks have been formulated for the realization of the set objectives, which adequately reflect the planned activities and correspond to the set goals.

### 4. Knowledge of the problem

The doctoral candidate has carried out a theoretical analysis and review of 73 literature sources on the topic of the dissertation, 43 of which are in Bulgarian, 30 in English. A significant number of Bulgarian and foreign authors have been correctly cited. The dissertation work is the result of a thorough research of the considered problems and creative application of the acquired knowledge and skills. Radka Todorova demonstrates theoretical and practical skills to independently conduct a comprehensive scientific research.

## 5. Research methodology

The dissertation research used a set of activities to collect empirical data, such as theoretical analysis and research on pedagogical experiences, and also their processing through mathematical-statistical analysis. The methodological approach used to carry out the research is a diagnostic procedure to control knowledge, skills and competencies. Theoretical and empirical research methods were used to realize the aims and objectives and to test the hypothesis: observation, comparison, analysis, synthesis, modeling, theoretical generalizations, group discussions, discussions with current mathematics teachers and tests. The doctoral student also used personal experience gained in teaching mathematics and in teaching mathematics with the application of DGS in schools. A didactic experiment was made and mathematical-statistical methods were applied to process the experimental data. The tools used include a system of tasks, tests and examination problems to test students' knowledge and skills. The chosen research methodology allows achieving the set goals and objectives.

## 6. Characteristics and evaluation of the dissertation

The dissertation of Radka Todorova is structured in the following parts: introduction, three chapters, conclusion, bibliography and four annexes. It contains a total of 188 pages, with 160 pages of main text, 13 pages of bibliography and 15 pages of appendices. The text is illustrated with a large number of figures that demonstrate the application of the developed tools in real learning situations. The main contributions, a list of publications on the thesis, an approbation of the results, a declaration of originality, perspectives for future development and acknowledgements are added.

In the Introduction, the main features and specifics of the used software products Sam and GeoGebra, which are used in solving the proposed geometry problem systems, are described. An overview and analysis of the tools used *Swap of Finite and Infinite points*, as well as *Connected Figures* is made. Other concepts, theorems, and theoretical statements on the subject are also explained.

Chapter I. presents learning activities on the topics of midpoint segment, centroid point and described Circumscribed Quadrangle studied in 8th grade, as well as geometric figures studied in 5th grade with bilingual students. A system of problems is provided for students to experiment on their own. A significant part of this chapter contains an introduction to Sam DGS, which is mainly used for teacher demonstration with subsequent independent

experimentation by students. A methodological approach for working in a specific learning environment for bilingual students is proposed.

Chapter II. focuses on an exploratory learning approach implemented with GeoGebra DGS, designed for students with an increased interest in mathematics. A problem from the 19th Balkan Youth Mathematics Olympiad, Serbia, 2012 is presented and the topic "Section of a polyhedron with a plane" is fully developed. Arguments for the choice of methodology and technology for organizing and conducting mathematics education using the relevant concept and methodological tools are explained. Possibilities for development of creative activity by application of dynamic educational environments in training are pointed out.

Chapter III is devoted to the diagnostic procedure. The details related to the planning and organization of the pedagogical experiment are presented, as well as the criteria and indicators for the evaluation of the effectiveness of the proposed technological model. The results of the study are statistically processed and analyzed, conclusions and implications regarding the working hypothesis are formulated.

The Conclusion presents the achieved results, formulates the main contributions, reports and publications on the results of the PhD thesis and presents some perspectives for future development. In the applications are included: a Survey of "bilingual students", Test, Questionnaire for expert evaluation and the results of the testing.

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

I acknowledge the contributions made by the dissertation and believe that they are sufficient for the award of the educational and scientific degree "Doctor". The main contributions resulting from the dissertation thesis are of scientific-applied and applied nature, and can be formulated as follows:

1) Development of task systems and methodological approaches for the use of dynamic geometry software in geometry classes in grades $5^{th}$, $8^{th}$, $9^{th}$ and $11^{th}$.

2) Application of DGS for research–oriented teaching in geometry to students – bilinguals and students with increased interest in mathematics.

3) Creating a didactic environment and learning technology through the application of DGS for the formation of creative thinking of students in geometry classes in grade $11^{th}$.

4) Development of methodological tools for training on the theme „Intersection of a polyhedron with a plane".

5) Development of a system of tasks using DGS for training on the theme „Intersection of a polyhedron with a plane", when specializing the type of section.

6) Creation of a test form for performing a diagnostic procedure with subsequent full analysis of the results.

The relationships between the contributions, the tasks, the place of description in the thesis and the publications made are described in a table.

## 8. Evaluation of the dissertation publications

PhD student Radka Todorova has submitted 6 publications in peer-reviewed journals on the topic of her dissertation. It is noteworthy that 3 of the publications are indexed in Web of Science (journal "Mathematics and Informatics"), 2 – in other refereed and indexed journals (1 in journal "Pedagogical Forum"), 1 in Global Journal of Advanced Research on Classical and Modern Geometries), 1 publication is in the Proceedings of the Scientific and Practical Conference "Mathematics, Informatics, Information Technologies, Application in Education", 10-12 October 2018, Pamporovo. This fact is sufficient as a quantitative and qualitative criterion for obtaining a scientific-educational degree "Doctor". The presented publications can be separated as follows: 5 articles in journals, 1 in the Proceedings of a National Scientific conference; 2 of the publications are in English, the rest are in Bulgarian; all publications are co-authored, with one co-author there are 4 articles, with two co-authors – 1, with more co-authors – 1. Radka Todorova is the second author in four of these publications.

A review of the submitted documents shows that the PhD student meets the minimum national requirements and exceeds the minimum of 30 points set out in the new regulations for the implementation of the LDASRB. There are 7 citations of her publications, 3 of them are in a monograph in English published by LAP LAMBERT Academic Publishing, 1 – in a journal indexed in Web of Science, 1 – in the proceedings of an International Conference abroad and 2 – in the Proceedings of National conferences.

## 9. Personal participation of the PhD student

Radka Zlatanova's high professional qualification and diverse pedagogical activity are the basis for conducting scientific research independently, as well as formulating the results obtained. After my acquaintance with the scientific works of the doctoral student, I believe that the results achieved are her personal work and were obtained with her active participation. It is noteworthy that the mentioned publications purposefully present separate parts of the dissertation research. This fact and the approbation made in practice are an indicator of the doctoral student's lasting interest in the researched problems.

## 10. Abstract

The submitted abstract is prepared in accordance with the requirements, consists of 32 pages, is relevant to the content of the dissertation text and reflects the main results achieved in the dissertation research.

## 11. Critical remarks, questions and recommendations

I have no critical remarks and recommendations.

**12. Personal impressions**

I do not know the PhD student personally and I have no direct observations from her work. My impressions of the provided materials and CV are for an excellent professional who works diligently and consistently on its development, with developed teamwork skills and active participation in National Programs and Projects implemented in school. The results achieved by Radka Zlatanova demonstrate her skills for effective solving of problems related to the educational process and her ability to conduct scientific and applied research.

**CONCLUSION**

The dissertation of Radka Todorova Zlatanova **contains scientific-applied, and applied results, which represent an original contribution to science and meet** the requirements of the Law on the Development of Academic Staff in the Republic of Bulgaria (LDASRB), the Regulations for application of LDASRB and the respective Regulation on the Development of the Academic Staff in University of Plovdiv "Paisii Hilendarski".

The dissertation shows that the doctoral student – Radka Todorova Zlatanova has a profound theoretical knowledge and professional skills in the Methodology of teaching Mathematics, as demonstrated qualities and skills to independently conduct research.

Due to all of the above, I confidently give my *positive assessment* of the research presented by the above peer-reviewed dissertation thesis, abstract, achieved results and contributions, and I **propose to the Honorable Scientific Jury to award the educational and scientific degree "Doctor"** to **Radka Todorova Zlatanova** in the Area of Higher education 1. **Pedagogical sciences**; Professional field 1.3.; **Pedagogy of teaching in….,** Doctoral program **Methodology of teaching in Mathematics**.

29.11.2021                                          Reviewer: ........................................

Plovdiv                                                      (Prof. Todorka Terzieva, PhD)