

OPINION

by Prof. PhD Veselin Nenkov Nenkov

Nikola Vaptsarov Naval Academy

Faculty of Engineering

of a dissertation for the award of an 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 of the dissertation: Radka Todorova Zlatanova

The topic of the dissertation: "**Formation of creative thinking in students in teaching geometry using dynamic geometric software.**"

Scientific adviser: Assoc. Prof. PhD Ivailo Peev Staribratov

1. General description of the submitted materials.

This opinion was prepared and based on order № P33-5349/22.10.2021 of the Rector of the University of Plovdiv "Paisii Hilendarski" Prof. Dr. Rumen Mladenov, according to which I was appointed a member of the scientific jury in connection with the defense procedure of the dissertation on the topic: "**Formation of creative thinking in students in the teaching of geometry using dynamic geometric software**" for obtaining the educational and scientific degree "Doctor" in the field of higher education: 1. Pedagogical sciences, professional field: 1.3. Pedagogy of teaching ..., doctoral program: Methodology of teaching mathematics by Radka Todorova Zlatanova, a part-time doctoral student at the Department of Training in Mathematics, Informatics and Information Technology at the Faculty of Mathematics and Informatics at the Paisii Hilendarski University of Plovdiv with supervisor Assoc. Prof. Ivailo Peev Staribratov.

As a member of the scientific jury, I have received all the necessary documents attached to the application of Radka Todorova Zlatanova to the Rector of the University of Plovdiv "Paisii Hilendarski" to open a procedure for obtaining an educational and scientific degree "Doctor". The documents are well-formed and arranged. These documents are the following:

1. Application form to the Rector for initiating a procedure;
2. Curriculum vitae in European format;
3. Minutes -2015-2021/2022, 14.09.2021 (from the preliminary discussion in the department);
4. Protocol №16-2021/2022, 18.09.2021 (for the satisfaction of the recommendations, jury proposal, and date);
5. Abstract:
 - 5.1. in Bulgarian;
 - 5.2. in English;
6. Declaration of originality and authenticity of the attached documents;
7. Information on compliance with the minimum national requirements;
8. List of publications;
9. List of observed citations;
10. Dissertation work;
11. Copies of the publications on the topic of the dissertation;
12. Certificate №16199/5 November 2015. Tru-2015 series for II PQD;
13. Set of documents on the electronic carrier from items 1-12.

2. Brief biographical data about the doctoral student

Radka Todorova Zlatanova was born on September 25, 1972 in the town of Karlovo. She completed her primary and secondary education in her hometown of Karlovo. In 1996, Radka Zlatanova graduated with a degree in Mathematics and Informatics from the Paisii Hilendarski University of Plovdiv. In the period 1996-2016, she worked as a teacher of mathematics and informatics at Hristo Prodanov High School - Karlovo. During the period 2007-2016, she also held the position of deputy director of the educational part of the same school. At the same time, in 2015, she obtained a Second Professional Qualification Degree in the Department of Information and Teacher Training at the Thracian University of Stara Zagora. From 2016 until now, Radka Zlatanova has been a teacher of mathematics at MHS "Acad. Kiril Popov"- Plovdiv.

3. Assessment of the relevance of the topic and the appropriateness of the set goals

It is well known that students have great difficulty in mastering the various geometric concepts and related statements. One way to overcome these difficulties is to use some dynamic geometric software. Through their visual and emotional means, software products have endless possibilities for translating difficult-to-understand concepts and statements into more understandable language. Therefore, they can be used in the development of various specific topics in mathematics. Every mathematical case is multifaceted and consequently impossible to exhaust. This makes any attempt to use a software product to develop a particular mathematical topic by making a transition from mathematical content to mathematical knowledge constantly relevant. This transition gradually shifts from increasing interest in the subject to one's own research. Therefore, this process leads to the formation of creative mathematical thinking, following the title of the developed dissertation. Consequently, I believe that the created topic is relevant. The goals set to clarify the answer to the question of whether creative thinking can be formed in students using dynamic geometric software (DGS) are natural and adequately set.

Finally, it should be noted that successful traditions have been established in Bulgaria in the use of various software products in mathematics education and, in particular, in geometry education. This dissertation is an example of continuing these traditions. In addition, it uses the software product Sam, created at the University of Plovdiv "Paisii Hilendarski" by Samet Karaibryamov under the scientific guidance of Assoc. Prof. B. Tsareva.

4. Characteristics, analysis, and evaluation of the dissertation

Radka Zlatanova's dissertation on "Formation of creative thinking in students in the teaching of geometry using dynamic geometric software" consists of 188 pages. It is structured in an introduction, three chapters, a conclusion, literature, and four appendices. The cited literature contains 43 titles in Cyrillic and 30 titles in Latin.

The introduction defines the purpose, object, subject, hypothesis, and tasks of the dissertation research. The content of the three chapters of the dissertation is extensively described in the introduction. The algorithm for the exchange of end and infinite points and its introduction with the operator SFIP in Sam and GeoGebra is described. Some of its appendices are also noted, which are further used in the main text. At the end of the introduction, some fundamental theorems of projective geometry are formulated, which appear additionally in more complex situations.

The first chapter contains systems of tasks that are proposed to be solved using the program Sam. Models of teaching in the study of the concepts of the middle segment and centroid of a triangle and a quadrilateral described around a circle are presented in detail. The topics covered gradually

move from more manageable tasks to more difficult and complex ones. The primary tool in the study of various situations related to particular types of quadrilaterals is the operator SFIP. The topic of quadrilaterals shows the natural generalisation of the described and externally described quadrilaterals around circles with conical sections and the application of Brianchon's theorem. This topic concludes with a consideration of variants for externally inscribed quadrilaterals on a task from the 53rd International Mathematical Olympiad held in Argentina in 2012.

The first chapter concludes with a study of the possibility of stimulating creative activity in bilinguals with the help of the DGS.

The second chapter contains task systems that have been proposed for solving using the GeoGebra program. The first part of this chapter discusses problems in which different geometric configurations are combined with circles. This naturally leads to the use of the properties of the mutual arrangements of a process and an angle.

In the second part of the second chapter, a task from the Balkan Youth Olympics, held in 2015 in Belgrade, is discussed. A detailed analysis of this task has been performed. After receiving its elegant solution, the stimulated and provoked search and discovery of a summary of the study are described. From the synopsis, some additional properties of the obtained more general geometric configuration can be noticed.

The third part of the second chapter is devoted to the study of sections of different polyhedron with a plane. The cross-sections are investigated depending on the location of the points and the type of the polyhedrons. Here again, the SFIP operator is essentially used. I consider this part being particularly informative, as it is much more challenging to consider spatial figures in the plane than to study plane figures. The main reason for this is the fact that the natural location of prisms and pyramids is not in the plane.

The third chapter describes a diagnostic procedure for controlling students' knowledge and skills. The results of the conducted diagnostic process show that "the use of interactive methods in mathematics education contributes to a more effective realization of the cognitive goals of education". Diagnostic research shows that the use of DGS increases students' interest in the topics covered, and some of them provoke innovative research that goes beyond the initially set tasks. This shows that the increase of the communicative possibilities between teacher and student through DGS contributes to better assimilation of the geometric material and causes the formation of creative thinking in the students.

5. Evaluation of the scientific and practical contributions of the dissertation

In the process of confirming the hypothesis underlying the dissertation, that through the developed didactic environment and technology of teaching with the use of DGS, creative thinking can be formed in students, the following author's contributions are reached:

1. Systems of tasks and methodological approaches for the use of DGS in geometry classes of 5th, 8th, 9th and 11th grades have been developed.
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 of 11th grade.
4. Development of methodological tools for training on the topic "Section of a polyhedron with a plane."
5. Development of a system of tasks through the use of DGS for training on the topic "Section of a polyhedron with a plane" when specializing the type of section.

6. A test form has been created for carrying out a diagnostic procedure with a subsequent complete analysis of the results.

6. Publications on the topic of the dissertation

The author has presented six publications on the topic of the dissertation, two of which are in English. The quantity and quality of these publications are sufficient to meet the requirements for obtaining the educational and scientific degree "Doctor".

7. Evaluation of the abstract

The abstract objectively reflects the main content of the dissertation.

8. Critical remarks and recommendations

I have no significant remarks on the present dissertation. The content of the dissertation is essential and deserves high praise.

9. Personal impressions

My good impressions of Radka Zlatanova are from the participation in various conferences and the articles published in the magazine "Mathematics and Informatics".

10. Conclusion

From all of the above it is obvious that Radka Todorova Zlatanova is a proven specialist in Methodology of Teaching in Mathematics with impressive achievements and accumulated experience in this field. She demonstrates quality and skills for independent research. This makes me conclude that the dissertation, the summary and the presented scientific production complies with the minimum national requirements, the requirements of ADASRB, the Regulations on its implementation, as well as the Regulations of Plovdiv University "Paisii Hilendarski" and the specific requirements of the Faculty of Mathematics and Informatics in PU for the academic staff development required to the candidates for obtaining the educational and scientific degree "Doctor". Therefore, **I give my positive evaluation** of the conducted study, presented by the above reviewed dissertation, summary, achieved results and contributions, and I would like to propose to the honourable members of the Scientific Jury to award the educational and scientific degree "Doctor" to Radka Todorova Zlatanova in the Field of Higher education 1. Pedagogical sciences; Professional field 1.3. Methodology of Teaching in...; Doctoral Program "Methodology of Teaching in Mathematics" with the strong believe that she deserves it.

28 November 2021

Beli Osam, Bulgaria

Signature:

/Prof. Veselin Nenkov, PhD/