

REVIEW

in relation to a dissertation public defense procedure
for obtaining the educational and scientific degree “Doctor”
on the topic “Formation of creative thinking in students
in teaching geometry using dynamic geometric software”
in the Field of Higher education 1. Pedagogical sciences;
Professional field 1.3. Methodology of Teaching in....;
Doctoral Program “Methodology of Teaching in Mathematics”

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1. General presentation of the procedure

The present review is prepared in accordance with Order No P 33-5349/22.10.2021 of the Rector of Plovdiv University “Paisii Hilendarski” – Prof. Dr. Rumen Mladenov, on the basis of the Decision (Protocol No 22/20.10.2021) of the Faculty Council of the Faculty of Mathematics and Informatics (FMI) and a report of Prof. Dr. Angel Atanassov Golev, Dean of FMI, in compliance with Art. 4 of the Act on Development of the Academic Staff in the Republic of Bulgaria (ADASRB), 2 (8), Art. 30 (3) of the Regulations on the Implementation of ADASRB and Art. 37 (2) of the Regulations on Development of the Academic Staff in Plovdiv University “Paisii Hilendarski” (RDASPU). With the cited Order, I am appointed member of the Scientific Jury for a public defense procedure of the dissertation on the topic “Formation of creative thinking in students in teaching geometry using dynamic geometric software” in the Field of Higher education 1. Pedagogical sciences; Professional field 1.3. Methodology of Teaching in....; Doctoral Program “Methodology of Teaching in Mathematics”. The author of the dissertation is Radka Todorova Zlatanova, a part-time doctoral candidate in Chair “Teaching in Mathematics, Informatics and Information Technologies”, while the scientific supervisor is Assoc. Prof. Dr. Ivailo Peev Staribratov.

The set of documents presented by Radka Zlatanova is in compliance with Art. 36 (1) of the Regulations on Development of the Academic Staff in Plovdiv University (RDASPU) and includes the following documents:

1. Sample application to the Rector to find procedure;
2. CV in European format;
3. Protocol No 15-2021/2022, 14.09.2021 (from the preliminary discussion in the Chair);
4. Protocol No 16-2021/2022, 18.09.2021 (proposal for a jury and a defense date);
5. Summary:
 - 5.1 in Bulgarian
 - 5.2 in English;
6. Declaration for originality and reliability of the attached documents;
7. Reference for the indicators of the minimal national requirements;
8. List of the publications;

9. Citations reference;
10. Dissertation;
11. Copies of the publications on the topic of the dissertation;
12. Certificate No № 16199/5th November 2015 Series TpY-2015 for II PCD;
13. Set of the paper documents 1–12;
14. Set of the documents 1–12 in electronic form.

The documents have been carefully presented and enable their examination and objective evaluation in accordance with the requirements of ADASRB and the Regulations on its implementation, also with the requirements of the Regulations of Plovdiv University and FMI.

2. Short description of candidate's CV

Radka Zlatanova graduated from The Professional High School in Mechanical Engineering “Bratja Evlogii and Christo Georgievi”, Karlovo in 1991 and holds the qualification “technician” in the specialization “electrical equipment of industrial enterprises”. In the period 1991–1996 she studied in PU “P. Hilendarski” and acquires the qualification “teacher in Mathematics and Informatics” in the specialization “Mathematics and Informatics”. In 2001 she defends fifth profession-qualification degree in the Department of information and improvement of teachers, Sofia, while in 2003 she defends also fourth profession-qualification degree in the Department of information and improvement of teachers’ qualification with Trakia University, Stara Zagora. In 2013 Radka Zlatanova passes 1-year profession-pedagogical qualification “Person-orientated education” in the Department of information and improvement of teachers at Sofia University “St. Cl. Ohridski”. The same year she acquires third profession-qualification degree in the Department of information and improvement of teachers, Sofia, while in 2015 she acquires also second profession-qualification degree in the Department of information and improvement of teachers’ qualification with Trakia University, Stara Zagora. In the period 1996–2007 Radka Zlatanova teaches Mathematics, Informatics and Information technologies in SOU “Hristo Prodanov”, Karlovo. There she improves herself in stimulating the process of cognition capabilities development of students, insurance of their permanent knowledge learning and support of their professional orientation. Also, she has been doing preparation for participation in mathematical contests and Olympiads. In the period 2007–2016 she is assistant director of educational activities in the same school, which helps her to acquire experience in the management and information services of educational initiatives. From 2016 on Radka Zlatanova teaches Mathematics in the Mathematical High School “Acad. Cyril Popov”, Plovdiv.

The education and creative CV of Radka Todorova Zlatanova directs her naturally to a higher degree of preparation and on 01.03.2020 she has enrolled a part-time doctoral studies in Chair “Teaching in Mathematics, Informatics and Information Technologies” of Plovdiv University “Paisii Hilendarski” on the topic and scientific supervision which are mentioned at the beginning of the present review. The doctoral studies have terminated ahead of schedule after a successful fulfilment of the planned activities and a decision of the Chair council with Protocol No 15-2021/2022, 14.09.2021.

3. Relevance of the topic and expediency of the planned goals and tasks

The development of the information and communication technologies gives possibilities for the creation of a corresponding environment to improve the ways of curriculum presentation and the connected pedagogical problems. Teaching should provoke interest for learning and perception of the novelty. Dynamic geometric software provides active participation in knowledge acquirement and enables trainees to become its co-discoverers. With its help students and university students observe and discover regularities, formulate and reject hypotheses, understand the essence of the

studied material more deeply. The implementation of such a software is an essential task of education, including education during pandemic, while a successful realization is a premise to master interest and to increase the effectiveness of teaching. Dynamic geometric software provides an environment to learn by doing and experiencing. The trainees are supported by the trainers who direct them to discover elements of the curriculum. Motivation is an essential condition for independent learning of the material, which leads to progress and development. The contemporary adolescent generation is “digital” and this requires digital competence without which the personal realization is unthinkable.

All this makes sense of the dissertation topic and proves its relevance. The focus is on the creation of a set of problems and methodological tools to teach Mathematics applying dynamic geometric software to topics of the educational curriculum in Mathematics for grades 5th, 8th, 9th and 11th.

4. Knowledge on the problem

About 80 literature sources with more than 30 in Latin script are researched. The doctorate candidate succeeds to agree the dissertation results with the most important achievements in connection with the issues under consideration. Bulgaria has traditions in the dissertation direction and Radka Zlatanova is familiar with them, no doubt. Furthermore, basis exists to conclude that she knows well the European frame of digital competence and uses it. The dissertation contains new ideas and results in the domain of Teaching Methodology in Mathematics.

5. Methodology of the study

Various and effective research methods are applied to fulfil the dissertation goals and to check the hypothesis that it is possible to shape creative thinking in students by means of the elaborated didactic environment and teaching technology with dynamic geometric software. They include: examination and analysis of pedagogical, methodological and teaching literature, which is connected with the research topic for constructing a theoretical base of the study. The methodological approach is a diagnostic procedure to control knowledge, capabilities and competences. Theoretical and empirical investigation methods are used in the realization of the goals and the tasks: observation, comparison, analysis, synthesis, modelling, theoretical generalizations, group discussions, conversations with acting teachers in Mathematics, tests. It is used the accumulated personal experience in Mathematics teaching and in Mathematics teaching with application of dynamic geometric software in school. Also, a didactical experiment and mathematics-statistics methods are used for the treatment of the experimental data. Tools, including a system of tasks, tests and exam problems are applied to check the existence of knowledge and skills. It is correct the author’s conclusion that the application of the elaborated diagnostic procedure improves the quality of the curriculum learning of students and increases the teaching effectiveness in educational environment assisted by dynamic geometric software. This concerns the topic “Section of a polyhedron with a plane” in Geometry teaching of 11th grade students, as well as the problem system impact on increasing the creative thinking during Geometry classes of grades 5th, 8th and 9th topics. The proposed methodology is suitable and it allows the achievement of the planned tasks.

6. Characteristics and evaluation of the dissertation

The dissertation consists of 188 pages (15 pages of which are appendices) and contains: a preface, three chapters, a conclusion, a bibliography and four applications. It includes a list of the author’s publications on the topic, prospects for future development, contributions of the study, an information about the participation of the doctorate candidate in scientific event for an approbation of the dissertation results, a declaration for originality and an expression of thanks.

The Preface describes the main characteristics and specifics of the used software Sam and GeoGebra, which are applied to solve the proposed systems of geometric problems. Also, a review

and analysis are realized concerning the used tools “Swap finite and infinity points” and “Connected figures”. Other related concepts, theorems and theoretical formulations on the topic are also explained. Chapter I discusses activities related to midpoint segment, centroid point and circumscribed quadrilateral which are studied in 8th grade, as well as geometric shapes studied in 5th grade. Systems of tasks for experimentation and independent realization are presented. The software Sam is mostly used for demonstration by teachers with subsequent independent experimentation by students. It is extremely interesting the generalization of a task from the 53rd International Mathematical Olympiad in Argentina in 2015. Also, it is proposed a methodological approach to activities in a specific environment to teach bilingual students. What initiates impression in Chapter II is a discussion of a task from the 19th Balkan Youth Mathematical Olympiad in Serbia in 2012, which is realized by means of GeoGebra and is directed to students with an increased interest to Mathematics. Concerning the topic “Section of a polyhedron with a plane” basic constructions and methods are viewed in relation with intersections and projections, which stimulate creative activity of students. Arguments are clarified for the choice of the methodology and the technology for the organization and conduction of Mathematics teaching with the use of a corresponding conception and methodological tools. Chapter III is dedicated to a diagnostic procedure, which is grounded theoretically, methodologically and experimentally. Details are clarified in relation with the planification and organization of a pedagogical experiment concerning the evaluation of the effectiveness of the proposed technological model. What are described are experimental groups, criteria and indicators for the evaluation of the teaching outcomes. The results themselves are processed statistically. They are analyzed and conclusions are formulated in relation to the working hypothesis. The Conclusion presents the achieved results, formulates the main contributions, reports and publications on the dissertation results and lists some perspectives for a future development. The applications include: the questionnaire “students-bilinguals”; a test; the questionnaire “expert evaluation” and the results of the executed testing.

The main conclusion is that the proposed methods develop creativity in students. Also, they develop logical and critical thinking, independent acquiring of knowledge and skill increase. This is a basis for a high evaluation of the dissertation. An expressive mention of the design should be done, which is of extremely high level and contains wonderful color drawings. This is the first time when I meet such a high level.

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

I accept Radka Zlatanova’s claim of the contributions in the way they are formulated in the dissertation and the summary. They include: the development of tasks and methodological approaches for the use of dynamic geometric software in Geometry classes in grades 5th, 8th, 9th and 11th; the application of dynamic geometric software to a research-oriented Geometry teaching of students-bilinguals and students with an increased interest to Mathematics; the creation of a didactic environment and teaching technology through the application of dynamic geometric software for the formation of creative thinking of students in Geometry classes in grade 11th; the elaboration of methodological tools for teaching the topic „Section of a polyhedron with a plane“; the elaboration of a system of tasks using dynamic geometric software for a training on the topic „Section of a polyhedron with a plane“ in the case of a specialized section; the creation of a test format diagnostic procedure with a subsequent full analysis of the results.

The obtained results confirm the dissertation hypothesis.

8. Judgment of the publications on the dissertation

The paper *Trifonova, P., N. Danova, R. Zlatanova (2013), Research-oriented teaching on the topic “The mid-segment and the centroid of a triangle” in a dynamic geometric environment, Pedagogy forum, Year 1*), 94--105, 2013, ISSN:1314-7986 (ERIH PLUS, NACID No 2932) proposes a teaching on the topic “The mid-segment and the centroid of a triangle” by means of a dy-

dynamic geometric software. The goal is to create an educational environment enabling students to experience personal ideas and whimsies, to feel themselves as discoverers reaching the assertions independently, to produce generalizations developing abstract thinking, which is characteristic for Mathematics. Six computer offices in SOU “Hristo Prodanov”, Karlovo are used as material base, which owns functionality and gives possibilities for a qualitative and innovative teaching in agreement with the needs of the contemporary information society.

The paper *Tsareva, B., R. Todorova (2013). Interactive study of circumscribed quadrilaterals in dynamic environment, Mathematics and Informatics, 56(2), 142--158, ISSN: 1310-2230, eISSN1314-8532 (Web of Science, Accession Number WOS:000447344600005)* proposes a new approach to the topic “Circumscribed quadrilaterals” which, as in the previous paper, allows students to feel themselves discoverers during the educational process and to enrich their knowledge on the topic depending on their interest and potentiality. The approach gives possibilities to master the strategy for the realization of dynamic drawings. This makes Mathematics education interesting, creative and “exciting” the way it is mentioned in the paper using the qualification of the world-known professionals in the field of Synergetics – S. Kurdjumov and Elena Knjazeva.

The goal of the paper *Grozdev, S., D. Stefanova, K. Vasileva, S. Koleva, R. Todorova (2014). Creative activity stimulation of bilingual students by dynamic software, Mathematics and Informatics, 57(3), 247--273, ISSN: 1310-2230, eISSN: 1314-8532 (Web of Science, Accession Number WOS:000450489800002)* is to show the possibility of dynamic geometric software to support the formation of mathematical culture in teaching of romani students under the conditions of bilingualism. Personal creativity of students is proposed to be applied to attractive further development of their ideas by means of the program Sam, which is easily perceptible and applicable. The expectations are enriched knowledge and acquisition of deeper digital competences. Executing experiments on figures develop heuristic skills and creative activity

The paper *Zlatanov, B., R. Todorova (2019). Using GeoGebra for the development of creative thinking of students in geometric classes, Proc. of the Science-practical conference “Mathematics, Informatics, Information Technologies, Application in Education, 10-12 October 2018, Pamporovo, 228--235, ISBN-978-619-202-437-6, (COBISS.BG-ID-1290308836)* considers the possibility of using GeoGebra in Geometry classes for the illustration of known tasks and the generation of new ones aiming at transforming students to discoverers. The pedagogical thesis is supported by the elaboration of a concrete task.

The paper *Staribratov I., R. Todorova (2019). One generalization of the geometric problem from the 19th Junior Balkan Mathematical Olympiad, Mathematics and Informatics, 62(2), 204--216, ISSN: 1310-2230, eISSN: 1314-8532, (Web of Science, Accession Number WOS:000465591000006)* is dedicated to a generalization of a task from the 19th Junior Balkan Mathematical Olympiad, which is presented to students from the Mathematical High School “Academician Cyril Popov”, Plovdiv. What are used are the program GeoGebra and the technique “diagram tree”, which help students to understand the solution and to be supported in the realization of the generalization steps.

The paper *Teofilova M., R. Todorova (2020). A New Improvisation on the Topic „Intersection of a Pyramid with a Plane”, Global Journal of Advanced Research on Classical and Modern Geometries, 9(1), 15--19, (MathSciNet, MR4312719)* is an application of an innovative method in the study of sections of solids with planes by using infinite points and the function „Swap finite & infinite points“ in GeoGebra environment. Four types of special sections are generalized in connection with parallelogram, rectangle, rhombus and square in the intersection of pyramids with planes. The approach represents a creative entertainment problem.

The publications are of high quality: 3 them are in the Journal “Mathematics and Informatics” which is referred and indexed in Web of Science, 2 are in other referred and indexed journals and 1 is in the Proceedings of a National conference. A sufficient approbation of the dissertation results is available. A proof is the Citations reference declared by the doctoral candidate including 7 noted citations. Among them are 3 ones in a monograph of the foreign Editing House LAP LAMBERT Academic Publishing, 1 in a journal which is referred and indexed in Web of Science, 1 in the proceedings of an International conference abroad and 2 ones in the proceedings of a National conference.

9. Personal participation of the doctoral candidate

Radka Zlatanova has doubtless personal contribution to the creation and application of the presented dissertation results to the educational practice. The fact that the publications are co-authored and independent ones are missing does not dispel the stated assertion. It may safely be said that the contributions in the papers which are used in class directly, belong to Radka Zlatanova. I have not discovered any plagiarism and there is no basis for doubts that the dissertation is a personal case of the doctorate candidate. I find that Radka Zlatanova has a real contribution to the development of the Methodology Teaching in Mathematics.

10. Summary

The Summary consists of 32 pages and reflects the dissertation content correctly. It is prepared qualitatively in agreement with the Act and the corresponding Regulations presenting the achieved basic results and contributions.

11. Critical remarks and recommendations

I have no critical remark.

12. Personal impressions

I know Radka Zlatanova personally only from the times when she has chaired UMB, Section Karlovo, and also from her participation in the Annual Assembly of the European Association “Kengourou sans Frontieres” in 2005.

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

I hope, that Radka Zlatanova will realize the prospects declared by her for future research development: an increase of the topics number using dynamic geometric software for illustration and search for new generalizations; development of didactic tests for other topics from the school curriculum except those in the dissertation; inclusion of the algebraic computer system Maple in Mathematics teaching parallelly to dynamic geometric software for illustration and support in laborious calculations; sharing and elaboration of materials with the use of computer systems jointly with colleagues – Mathematics and Informatics teachers.

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 con-

clude 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.

Sofia, 28 November 2021

Reviewer:

(Prof. Dr. Habil Sava Grozdev)