

REVIEW

of the application for academic position "Associate Professor"
in the field of higher education: 1. Pedagogical Sciences
Professional field: 1.3. Pedagogy of Teaching... (Mathematics)
for the needs of Sofia University "St. Kliment Ohridski",
Faculty of Mathematics and Informatics

1. General presentation of the procedure

In SG 87/19.10.2021, a competition was announced for the selection of an "Associate Professor" in Professional field 1.3. Pedagogy of Teaching... (Mathematics) for the needs of the Faculty of Mathematics and Informatics (FMI), Sofia University "St. Kliment Ohridski". The only candidate in the competition is Chief Assistant Professor Irina Zdravkova Voutova, PhD. This review is based on Order № ПД 38-592/10.12.2021 of the Rector of Sofia University "St. Kliment Ohridski" (SU) - Prof. Anastas Gerdjikov, DSc, on the basis of the decision of the Commission for Admission to the Competition, appointed by Order ПД 38-590/10.12.2021 of the Rector. By Minutes of 21.12.2021, the Commission unanimously found that all the necessary documents for participation in the competition, according to Article 107 (1) of ПУПНЧЗАД in SU, were present and admitted the applicant to the competition. On the basis of the Minutes of the first meeting of the Scientific Jury dated 22.12.2021, the candidate's eligibility has been verified in accordance with the minimum national requirements and the additional requirements of SU, according to Article 105, item 4 of ПУПНЧЗАД in SU. The Scientific Jury has verified the compliance of the transcript submitted by the candidate with the minimum national requirements and with the additional requirements of SU, according to Article 105, items 4 and 5 of ПУПНЧЗАД in SU. The Scientific Jury has unanimously decided that the candidate meets the national minimum requirements under Article 25, paragraphs 2 and 3 of the Academic Staff Development Act in the Republic of Bulgaria (ЗПАСРБ), based on all documents submitted by the candidate. No plagiarism in scientific works has been legally proven.

As a member of the Scientific Jury, I have found no procedural irregularities. I received access to the documents and materials of the only candidate in the competition, Chief Assistant Professor Irina Zdravkova Voutova, PhD, which are carefully prepared and allow for an objective and complete evaluation in accordance with the requirements of ЗПАСРБ and the Regulations for its application, as well as the Regulations of Sofia University and FMI.

2. General presentation of the applicant

Chief Assistant Professor Irina Voutova, PhD in 1993 graduated from the High School of Natural Sciences and Mathematics in Vratsa, and in 1998 from "John the Exarch" Language High School in Vratsa with English as her main language. Then she graduated the Faculty of Mathematics and Informatics at Sofia University. She holds a Master's degree in Mathematics and

Informatics. In 2000 she graduated with a Master's degree in Economic Management at the Faculty of Economics of Sofia University. In the same year she graduated from Erasmus University, Faculty of Economic Sciences as a Master in Economics and Management in Rotterdam, the Netherlands. In the period 1998–2005, Dr. Voutova was a Visiting Assistant Professor at the Department of Geometry of the Faculty of Mathematics and Informatics at Sofia University. From September 2000 to August 2002 she was a teacher in Mathematics at “Miguel de Cervantes” Spanish Language School, Sofia, and from September 2002 to August 2005 she was a teacher in Mathematics at “Alphonse de Lamartine” French Language School, Sofia. Since February 2005 she has been an Assistant Professor at the Department of Teaching in Mathematics and Informatics (TMI) of the Faculty of Mathematics and Informatics at Sofia University, from August 2009 to August 2010 she was a Visiting Assistant Professor in Mathematics in English at the Department of Foreign Language Teaching at Sofia University, and in the period 2011 - March 2017 she was a teacher in Mathematics at “Doris Tenedi” Private School in Sofia. In 2014 Irina Voutova defended a doctoral thesis, titled "Heuristic and Prognostic Role of Theorems in Mathematics School Course" in the field of 1.3. Pedagogy in Teaching in... (Mathematics) at FMI, Sofia University. Prof. Ivan Tonov, PhD was her scientific advisor. Chief Assistant Professor Irina Zdravkova Voutova, PhD was the leader of a research project at Sofia University, titled "Research in the Field of Current Educational Monitoring" – 2016 and a team member of 10 other research projects, such as the international TEMPUS PROGRAME. She was on working visits at the University of Belgrade, Republic of Serbia and at the University of Joensuu, Finland. She speaks English and Russian, has good communication skills acquired during her teaching work and participation in various forums in mathematics education, has excellent teamwork skills acquired while working on national and international projects, has organizational skills, acquired mainly in providing the teaching practice of students in school. The candidate's digital skills include information processing, communication, content creation, security and problem solving. Irina Voutova has participated in seminars at the Department of Teaching in Mathematics and Informatics, is a member of the Commissions for the State Practical Exam for Acquisition of Teaching Qualifications in Mathematics, in the period 2018-2021 was an assessor in the Expert Commission in Mathematics for 7th grade at the Center for Education and Science of the Ministry of Education and Science. She is a member of the Union of Mathematicians in Bulgaria.

3. Presentation of the candidate's scientific works

Chief Assistant Professor Irina Zdravkova Voutova, PhD's scientific works are rich and varied. Out of a total of 46 publications, including 3 monographs, 4 books, 5 school appliances, 3 studies in scientific journals, 13 articles in scientific journals and 18 articles in conference proceedings, for the competition she presented 1 monograph - main habilitation work by Indicator B.3., 1 monograph by Indicator Г.4., 5 publications by Indicator Г.6. (Articles and reports published in scientific journals, referenced and indexed in internationally-recognized databases of scientific information), 9 publications by Indicator Г.7. (Articles and reports published in unreferenced journals with scientific review or in peer-reviewed journals) and 3 publications by

Indicator Г.8. (Studies published in scientific journals, referenced and indexed in internationally-recognized databases of scientific information).

In the monograph Voutova, I. (2020), *Theorems, Analogy, Heuristics or Theorem-Hypothesis-Theorem Prim*, Sofia: University Publishing House “St. Kliment Ohridski”, ISBN 978-954-07-4914-3, is developed the thesis that theorems are a “reliable source” of new hypotheses and new theorems in addition to “building material”. Much of the new knowledge results from analogies and generalizations of already established knowledge. The classical “plane-space” analogy is implemented by vector-algebraic modeling. The theoretical part combines the idea of theorems as a prototype of new hypotheses with a high degree of plausibility and the idea of the natural heuristic capabilities of vector-algebraic modeling. A “heuristic transition” strategy from the plane to n -dimensional spaces ($n \geq 3$) is derived. In the practical part, the effect of the hypothesis formulation strategy was approbated and confirmed. The quadrilateral area theorem from the Geometry School Course is used and generalizations related to the octahedron are made. Analogues of the triangle (tetrahedron) and quadrilateral (octahedron) are introduced for “outlets” in n -dimensional spaces ($n \geq 3$). Invariants of point configurations that are analogues and generalizations of area and volume are proved. Hypotheses are formulated for the n -dimensional space for $n > 4$.

The monograph Lalchev, Z., I. Voutova (2009), *Vector-Algebraic Method for Solving Geometric Problems of Collinearity and Competitiveness*, Sofia: VEDA SLOVENA - JG, ISBN: 978-954-8846-11-0, is intended for teachers in Mathematics and school students - future students in natural sciences. It is shown that affine vector algebra can be used as a standard approach to problems of collinearity of points and competitiveness of lines. The first part is preparatory. It outlines two main stages of the process of forming skills for working with vectors - without and with the use of a base. In the second part, instead of using barycentric coordinates and vector product, spatial analogues of Menelaus' and Ceva's theorems are derived using only affine operations without using metric ones. By the means of vectors, it is established that for each tetrahedron the first and the second Ceva points (the common point of Cevians and the common point of transversals, respectively) coincide. A formula for the radius vector of the point is derived.

Of the articles, those in “Mathematics and Informatics” Journal, which is referenced and indexed in Web of Science, stand out. One of the papers is dedicated to the inductive approach to entertaining problems related to the motion of a light ray in a rectangular gallery with mirrored walls, in three of the corners of which pictures are placed. The trajectory of the light ray, the number of its reflections and the number of the illuminated picture are predicted. Methodologically, the study is a continuation of Perelman's geometric method for solving the Poisson's problem. In another paper, based on the so-called MZ-map, a criterion for the necessity of introducing an unknown and using a mathematical model with constitutive equations in solving arithmetic problems in primary school mathematics is formulated. In the third article, the category of “problem structure” is introduced. A logical-mathematical classification of elementary arithmetic problems is made on the basis of a “list” of 12 types of problems, in which 24 classes are covered. Each class is represented by a concrete example in which the structural and

mathematical models of the problem are shown. The paper reflects the constructivist approach in mathematics education. In the fourth paper, the concept of “arithmetic equation” is introduced and it is shown that there is a mutually unique correspondence between elementary arithmetic equations and elementary arithmetic transformations, in which the rules for finding the unknown component correspond to inverse arithmetic transformations. From a mathematical point of view, the two approaches are equivalent, but from a methodological point of view the inversion method is preferable because its “steps” can be visualized by a “chain diagram” and thus a lower level of abstraction can be realized. In one of the articles in “Mathematics and Informatics” Journal are presented the theorem of the common point of Cevians and the theorem of the common point of transversals using only affine vector operations. The results are part of the monograph discussed above. In another article, a specific continuation of the idea of area and volume from the Geometry School Course is made. It is shown that the geometric figures quadrilateral and octahedron are concretizations of diagonal point configurations. The invariant of these configurations are analogues to the concepts of area of a quadrilateral and volume of an octahedron. A unified approach to developing the concept of “diagonal” invariants in n -dimensional space ($n \geq 2$) is proposed. In subsequent paper, the idea of an invariant of an elementary point configuration in n -dimensional space is extended. A “diagonal principle” for composing and transforming matrices is formulated. The subject of research in another article is the construction of mathematical models of problem situations arising from additive operations (union, intersection, complementation) with finite sets in elementary school mathematics. A comparative analysis of two methodological approaches for modeling and solving problems of additive operations with sets and natural numbers is made. It includes the method of “Euler-Venn diagrams” and method of “MZ-maps”. The idea of complementing the two approaches in problem solving is well-founded.

Publications in unreferenced journals address a variety of issues. The idea that learning by “teaching” is ineffective and needs to be replaced by learning by “recreating” mathematical knowledge is defended. An innovative form of teaching called “academic lesson” is proposed. A method for solving three-vessel fluid pouring problems (Poisson's Problem) is presented. The method is based on elementary geometric constructions used by Y. I. Perelman. It is described in detail using elementary means of analytical geometry and presented through specific pouring problems. The role and place of binomial relations in the school mathematics course is examined. The corresponding classification reveals the property “reflexivity”, as four groups of relations are formed. Study methods are proposed for each. The idea that vectors can be the basis for making cross-curricular connections is launched. For this purpose, problems from school courses in algebra, geometry, physics, chemistry and practical problems, which solutions go through vector-algebraic models, are presented. An overview is made of Byzantine mathematics, which not only inherited and preserved the ancient Greek mathematical thought, but also had a strong influence on the mathematical knowledge of the peoples of Eastern Europe, including the Bulgarians. An unconventional way of finding the volume of an octahedron is presented, and a new stereometric theorem is proved. It allows the volume of the octahedron, but also of other polyhedra to be calculated directly, without supplementing or splitting. It suffices to find the volume of a

tetrahedron, which defining vectors are given by the diagonals of the octahedron. Methodological solutions for introduction and study of vectors in the school geometry course are proposed. The possibility of starting from a particular vector space, such as the vector space of radius-vectors, and the proceeding to the vector space of classes of equal directed segments is justified. The possibility of constructing of the so-called “intermediate stations”, through which both the condition and the conclusion of the problem are “visible”, is proposed. An “intermediate station” can be an appropriate segment - connecting segment, a suitable angle - connecting angle, an appropriate algebraic expression - connecting expression. The connecting role of these elements is shown.

The candidate’s 4 section papers as a participant in scientific conferences should be noted: “Perelman's Geometric Method of Solving Liquid Pouring Problems”, “The Reflective Property of Binumeric Relations”, “Introduction to Mathematics” and “Vectors as a Basis of Subject Interrelations in School Mathematics”.

I accept the contributions to the theory and practice of mathematics education as formulated by the candidate. There is no doubt that they represent Chief Assistant Professor Irina Zdravkova Voutova, PhD as a high-value specialist in the field of mathematics education methodology. This is evidenced by the 23 citations noted.

4. Presentation of the candidate's teaching activity

The teaching activity of Chief Assistant Professor Irina Zdravkova Voutova, PhD includes:

- seminars in “Didactics of Mathematics” with full-time students and distance learning students in “Mathematics and Informatics” Bachelor’s Program; students in optional module “Teacher in Mathematics”; students in postgraduate qualifications “Teacher in Mathematics” and “Teacher in Mathematics and Information Technology”;
- lectures and seminars in “Didactics of Mathematics” with full-time students and distance learning students “Physics and Mathematics” Bachelor’s Program;
- “Teaching Mathematics – School Practice” with full-time students and distance learning students “Mathematics and Informatics” and “Physics and Mathematics” Bachelor’s Programs, and students in optional module “Teacher in Mathematics”;
- “Current Pedagogical Practice” with full-time students and distance learning students “Mathematics and Informatics” and “Physics and Mathematics” Bachelor’s Programs, and students in optional module “Teacher in Mathematics”;
- lectures and seminars “Management in Education” with full-time students and distance learning students in “Technology in Mathematics and Informatics” Master’s Program;
- lectures and seminars in “Inclusive Education” students in postgraduate qualifications “Teacher in Mathematics”, “Teacher in Mathematics and Information Technology” and “Teacher in Informatics and Information Technology”.

In addition to Chief Assistant Professor Irina Voutova, PhD’s teaching activity, it should be noted that she is a co-author of 5 approved school appliances in mathematics for students 1st – 4th grades (one), 5th – 7th grades (two) and 8th – 12th grades (two).

5. Presentation of the candidate's applied scientific activity

Chief Assistant Professor Irina Zdravkova Voutova, PhD has participated in the following research projects:

2021, "Methodological Approaches for Increasing Learners' Achievements in Application of the Competence Approach", team member, Contract № 80-10-152;

2020, "Targeted Use of Organizational Forms Set Out in the New Curriculum of the Ministry of Education and Science in the Cultural-educational Field of Mathematics, Informatics and Information Technology", team member, Contract № 80-10-199;

2019, "Organizational Models for Extracurricular Activities in the New Curricula of the Ministry of Education and Science in the Cultural-educational Field of Mathematics, Informatics and Information Technology", team member, Contract № 80-10-210;

2016, "Research in the Field of Current Educational Monitoring", team leader, Contract № 143;

2015, "Creation of a Bank of Test Problems for Diagnosing the Results in Mathematics, Informatics and Information Technology Education", team member, Contract № 140;

2014, "Creation of a Bank of Test Problems for Diagnosing the Results in Mathematics, Informatics and Information Technology Education", team member, Contract № 126;

2013, "Current Issues in the Training of Teachers in Mathematics, Informatics and Information Technology in Different Forms of Education", team member, Contract № 190;

2012, "Current Issues in the Training of Teachers in Mathematics, Informatics and Information Technology in Different Forms of Education", team member, Contract № 105;

2011, "Problems of Current Education in Mathematics - Extracurricular Activities, team member;

2006, "Teacher Education - Innovation of Studies in Mathematics and IT" (TEMIT), team member, Contract № CD_JEP-41110-2006 (RS).

CONCLUSION

It is evident from the foregoing that Chief Assistant Professor Irina Zdravkova Voutova, PhD is a proven specialist in mathematics teaching methodology with impressive experience in this field. Her scientific works meet the national minimum requirements under Article 25, paragraphs 2 and 3 of ЗПАСРБ in the scientific field: 1. Pedagogical Sciences, professional field: 1.3. Pedagogy of Teaching... (Mathematics). Her works have been repeatedly cited. There is no reason to believe that they are not her personal work, which rules out plagiarism. This gives me grounds to conclude that her scientific, scientific-applied, teaching activity and qualities satisfy the requirements of ЗПАСРБ, the Regulations for its application, as well as the Regulations of Sofia University "St. Kliment Ohridski" of the Academic Staff Development for the academic position of "Associate Professor". Therefore, I give a **positive conclusion on the election for "Associate Professor"** and I take the liberty to propose to the honorable members of the Scientific Jury to support this nomination and to make a proposal to the Faculty Council of the Faculty of

Mathematics and Informatics at Sofia University “St. Kliment Ohridski” to elect Chief Assistant Professor Irina Zdravkova Voutova, PhD for “**Associate Professor**” in **Mathematics Teaching Methodology** with the conviction that she deserves.

Sofia, January 23, 2022.

The review was prepared by:

(Prof. Sava Grozdev, DSc)