

## SUMMARY OF PUBLICATIONS

of Assoc. prof. Kalina Ivanova Alexieva, PhD

for participation in the competition for the occupation of the academic position of "professor" in the field of higher education: 1. Pedagogical sciences, professional direction: 1.3. Pedagogy of teaching in... (Methodology of teaching mathematics in elementary grades), announced by "Konstantin Preslavsky" University of Shumen in the State Gazette, no. 82/14.10.2022

### I. MONOGRAPHS:

#### 1. Habilitation work:

**Aleksieva, K.** Modeling and visualization in creative work in mathematics. Shumen: UPH "K. Preslavsky", 2022, ISBN 978-619-201-645-6, 176 pages.

#### *Summary :*



The monographic work *aims* to emphasize the practical significance and role of modeling and visualization as a leading method and tool in mathematics education. Innovative technological options for solving mathematical and practical tasks from elementary school mathematics using didactic modeling are presented. The purpose of the research determines the solution of the following *tasks* : to outline a concept for learning basic knowledge of primary school mathematics, which is consistent both with the logic of modern mathematics and with the age characteristics of the students; to propose systems of tasks ensuring the formation of students' skills for solving tasks with the help of structural-functional modeling

and to develop modern didactic models; to test developed modern approaches for learning traditional and modern mathematics content with students and pupils.

The following *methods* were used for the realization of the tasks: research and analysis of the problem and its solutions in literary sources; development of modern didactic models for teaching traditional and modern arithmetic questions to students - future primary teachers; testing the developed didactic models, correcting and enriching them after each training course for students from bachelor's and master's programs.

The development is organized into two chapters, deductions and conclusion.

*Chapter one* presents a set of theoretical positions, concepts and views of many scientists regarding the principle of visuality and its implementation in the modern stage of mathematics education. The problem of the nature of models and modeling in mathematics education is considered. The application of graphic visualization and modeling in mathematics education is defined in a theoretical-practical plan. The relationship between modeling and visualization with a view to achieving accessibility in the learning process is demonstrated. The concept of *creative task* and the concept of *creative activity* in mathematics education are analyzed. The

basic requirements, principles and rules regarding the thematic structuring of the learning content in the elective lesson are specified, with which to assist in the optimal development of the mathematical competences of children in primary grades.

*The second chapter proposes structural, structural-functional and mathematical-logical models of mathematical and practical tasks (elementary and composite tasks). The structural models are presented with an Euler-Venn diagram (13 tasks), the structural-functional models are presented with squares and arrows diagrams (21 tasks) and with a drawing (16 tasks), and the mathematical-logical models are presented with tables (26 tasks from Diophantine equations and 20 logical problems) and with a tree diagram (12 problems).*

The tasks that illustrate the modeling and visualization ideas are from the mathematics curriculum for the primary grades, with resources generated from teaching aids for extracurricular forms of work, teaching aids for the elective lesson and free-choice preparation, math competitions, olympiads and other sources.

At the end of each paragraph, ideas are presented for structural and structural-functional modeling of tasks from independent works of undergraduates from "bachelor's" and "master's" degrees, trained on the subject.

In the final part of the book, general didactic and practical-applied conclusions are drawn, as a result of the direct methodical and research work of the author.

## 2. A published monograph that is not submitted as a major thesis

**Aleksieva, K.** Didactic-methodical technologies for the formation of initial mathematical concepts. Shumen: UPH "K. Preslavsky", 2022, ISBN 978-619-201-644-9, 182 pages.



### *Summary:*

The changes that came into force with the promulgation of the Law on Preschool and School Education make it necessary to subordinate the main purpose of education to the development of skills for working with constantly changing information and mastering learning methods, to key competences and attitudes to learning through whole life. The increasing mobility, the rapid development of communications, urbanization and the change of social structures within the EU and the world require a change in the philosophy of school education.

The problem of the formation of elementary mathematical concepts in elementary school students is not new. Almost all our methodologists, who worked on building the theoretical foundations of mathematics education, dealt with its resolution. Of particular relevance and significance for theory and practice is the work of Alexander Madzharov on the didactic and psychological aspects of the work in the formation of elementary mathematical concepts and the system for their introduction in schools, which are also the subject of the study.

The emphasis is on current trends in mathematics education, in the context of changing educational paradigms.

The purpose of the book resonates with the respect of the good traditions in our educational system and with their presentation in accordance with the normative documents reforming the Bulgarian education.

In the first part, basic didactic and psychological theoretical statements are presented, which are the basis of the construction of mathematical concepts in children. Problems related to: *the role of education in building mathematical concepts; the nature of mathematical concepts; mathematical thinking and thought processes in the formation of abstract mathematical concepts* are analyzed.

The second part examines the concept of Al. Madzharov for the formation of elementary mathematical concepts and the methodical system of their introduction at school in the context of modern productions for the implementation of the learning process in mathematics in grades I - IV.

The didactic-methodical technologies developed on this basis are tailored to the specifics of mathematics education in the primary course, and are presented in an order that meets the modern requirements in primary teacher education. Didactic technologies are proposed for learning the concepts - *natural numbers and working with subject sets; certain numbers (the number one, zero, etc.); about arithmetic operations and the mathematical basis of their construction, about the interrelationship between individual arithmetic operations and their basic properties.*

The third part examines in detail the current content and state of mathematics education - normative basis and didactic assurance. The curricula and the teaching content in mathematics for grades I-IV are commented on. Based on the author's research study, conclusions are drawn regarding: *mathematical preparation, readiness for school and measuring the achievements of modern seven-year-old children* - problems that resonate with the implementation of the continuity of the transition from preschool to school education.

Observations and a series of studies show that educational practice requires permanent feedback on problems in the acquisition of basic mathematical knowledge in order to apply adequate and timely measures to overcome them. In this sense, the considered problematic questions and technological solutions can serve as a tool, a guide and a support in the methodical activity of elementary teachers, to increase the quality of mathematics education and to develop the mathematical competence of students.

## II. ARTICLES:

**1. Alexieva, K.** The inversion method in teaching mathematics in 1st - 4th grade. Yearbook of "K. Preslavsky" University of Shumen, Faculty of Pedagogy, Volume XXVI D, UPH "K. Preslavsky", 2022, ISSN 1314-6769

### *Summary:*

In the article we consider the *method of inversion* or *the method of reverse actions*, its essence and expediency from studying it. We present a set of over 20 tasks of the "back-to-front" or "crab" type, from the educational content for the mandatory preparation and from the educational aids for the elective class of some of our publishers.

The tasks that are solved *using the inversion method* contribute to the development of students' logical thinking, and it is extremely important for elementary teachers to apply this method in the learning process.

This type of task arouses students' interest and they work willingly to discover the answers along the way of the algorithm for drawing up reasoning schemes and applying the

method of inverse operations. The fun element in solving "crab tasks", the interesting and engaging way of creating diagrams with squares and arrows and performing actions, makes solving them interesting and understandable for students, enriches and develops their mathematical competences, provides a pleasant and stimulating environment that contributes to a positive attitude towards learning, encourages, motivates and helps to develop the full potential of each student.

**2. Aleksieva, K.** Application of the method of inverse operations in the teaching of mathematics in 1st - 4th grade. Yearbook of "K. Preslavsky" University of Shumen, Faculty of Pedagogy, Volume XXVI D, UPH "K. Preslavsky", 2022, ISSN 1314-6769

**Summary:**

The development examines the practical application of the method of inverse operations, regarding the essence of *the inversion method*, based on the interrelationships between arithmetic actions for solving the "crab tasks" known in the literature for primary school age. A system of exercises is proposed, which includes different types of tasks of increasing difficulty, with the aim of more fluent, accessible and lasting learning by students.

The development presents **15 sample tasks** that illustrate various variants of mathematical and practical tasks, of the "crab" type. They are easily recognized and solved with ease after enough practice.

The interesting and fascinating way of constructing and deciphering the diagrams by performing actions opposite to those set in the condition makes solving these seemingly "difficult tasks" entertaining, enjoyable and understandable for students.

**3. Aleksieva K.** Creative exercises for composing word problems in direct and indirect form. SocioBrains, [www.sociobrain.com](http://www.sociobrain.com), Bulgaria, Issue 96, August 2022, pp. 20-26, 2022, ISSN 2367-5721 (online)

**Summary:**

The article focuses on creative exercises for writing word problems. Writing word problems is one of the most interesting and popular exercises of a creative nature. They contribute to strengthening the children's knowledge about the elements of the text task and, accordingly, about the very concept of a text task. There are **12 variants** of text tasks by assignment : *graphic model, abbreviated record, schematic model, mathematical model, based on data from a table* , etc., which are extremely diverse in terms of content and plot. The activities of their composition contribute to the development of students' thinking and their intellectual growth.

**4. Aleksieva, K.** The drawing as a means of visualization in the creative work on textual tasks. (Drawing as a means of visualization in creative work on text tasks). SocioBrains, [www.sociobrain.com](http://www.sociobrain.com), ISSUE 94, JUNE 2022, pp. 8-14, 2022, ISSN 2367-5721 (online)

**Summary:**

In order to increase the quality of students' competences and to achieve higher results in the development of their cognitive activity, a rich variety of *graphic visual aids* are applied in the initial stage of education when solving *text tasks* .

The article presents **nine example problems** that illustrate different options for visualizing mathematical and practical problems, set with a complicated and complex condition using a drawing, as well as the visualization of their solutions and answers.

Of course, similar tasks in the next stage of learning are solved using equations, but they also have accessible and interesting options for arithmetic solutions. Results of the teaching practice show that the *graphic models* of the tasks make mathematics understandable to the students, arouse interest in the subject and provoke creative activity.

**5. Aleksieva, K.** Application of Euler and Venn diagrams in primary school

mathematics. (Application of Euler-Venn diagrams in mathematics education in primary grades). SocioBrains, www.sociobrains.com, ISSUE 94, JUNE 2022, pp. 15-22, 2022, ISSN 2367-5721 (online)

**Summary:**

In the article, we consider the concept of the development of mathematical abilities by solving different types of non-standard tasks. A system of 7 variant problems is presented, which involve operations with sets (*unification, intersection, completion of "overlapping" sets*) which are solved using the well-known **method of Euler-Venn diagrams**. *The system includes 4 types of tasks: when there is an intersection of two basis sets; when there is an intersection of three basis sets; when there is a partial intersection (two by two) of three basis sets; when there is an intersection of more than three basis sets.*

The idea is that, in the course of their work, elementary teachers can vary the numerical data and the plot of the text of the presented options, thereby enriching the learning content on this extremely interesting and entertaining topic, which is unjustifiably underrepresented in math classes.

**6. Aleksieva, K.** Diophantine equations for voluntary mathematics classes in primary teaching. (More on the Diophantine equations in the optional mathematics lesson in elementary grades). SocioBrains, www.sociobrains.com, ISSUE 93, MAY 2022, pp. 94-99, 2022, ISSN 2367-5721 (online)

**Summary:**

In the development, we present technological options for solving various mathematical and practical tasks with the help of *Diophantine equations*, which educators can use in their practice. A system of **6 groups** of practical and mathematical problems is structured, which are solved by Diophantine equations of the first degree and have *one, two, three, four or more solutions; or have no solution; or their solutions are determined by additional constraints.*

The developed system of *12 mathematical and practical problems*, the solution of which is reduced to solving Diophantine equations with one, two and more solutions, without a solution and with additional questions or restrictions, contributes to more attractive and fruitful learning.

**7. Aleksieva, K.** Exercises on built models in the teaching of mathematics in grades I - IV. (Exercises on built models in the teaching of mathematics in I - IV grades). SocioBrains, www.sociobrains.com, ISSUE 95, JULY 2022, pp. 87-92, 2022, ISSN 2367-5721 (online)

**Summary:**

Creative work on built models can be of several types: *establishing correspondence between a model and a text task; compilation of tasks according to a given model; discovering new connections between what is given and what is sought after building a model of a given task and its solution; assembling the individual components of the tasks and relating the resulting tasks to a schematic and mathematical model; according to a given model and from a series of formulated tasks to determine the one that corresponds to the model, etc.*

Activities in working on built models in mathematics education, depending on the degree of independence of students, contribute to the development of thought processes and problem-solving skills from real practice.

**8. Aleksieva, K.** Creative work on model building in the education of mathematics. (Creative work on model building in teaching mathematics). SocioBrains, www.sociobrains.com, ISSUE 88, december 2021, pp. 83-89, 2021, ISSN 2367-5721 (online)

**Summary:**

The structure of many problems in elementary mathematics can be modeled and visualized in a variety of ways - tabular, Euler-Venn diagrams, graph-tree diagram, box-and-arrow diagram, drawing, graphs, "magic segments" and other graphic-symbolic means.

The use of graphic language in mathematics lessons in elementary grades is preferable, since with its help the studied relationships and dependencies can be clearly emphasized. When using object language, these relations do not stand out to such an extent because they remain in the shadow of the numerous properties of objects. The presentation of the same abstract mathematical material in graphic and symbolic language helps the student to better understand it, encourages perception and assimilation of this material, to rationality and awareness of thinking.

In the development, we consider **6 sample variants** of creative work on building models with the help of **graphs, "magic segments" and diagrams** (matrix and graph-tree). It is clear from the proposed tasks that the use of *diagrams and graphs* in the creative work of building *models* brings dynamics and economy, stimulates the interest and creative thinking of students.

**9. Aleksieva, K.** The elective lesson in mathematics for the development of the mathematical abilities of children in primary grades. Yearbook of "K. Preslavsky" University of Shumen, Faculty of Pedagogy, Volume XXV D, Veliko Tarnovo, UPH "K. Preslavsky", 2021, 403-410, ISSN 1314-6769

**Summary:**

Mathematics education is oriented towards the mastery of mathematical knowledge, skills and attitudes related to the modern key competences of students. Through it, arithmetic and geometric knowledge and skills are upgraded, enriched and improved, logical thinking, observation and creative imagination are developed, the ability to interpret and use information presented in different ways, the ability to work independently and to work in a team is developed.

The implementation of the curriculum for the optional training implies the use of a variety of methods, forms and means of training.

In the article, we present **15 problems** of the *Diophantine equations* type, which, having been solved, would make it possible to contribute to the development of students' *mathematical abilities*.

**10. Aleksieva, K.** Creative work on word problems in mathematics in the fourth grade. UPH " K. Preslavsky", In: The competence approach in education - traditions and innovations, Shumen, 2021, ISBN 978-619-201-522-0, pp. 120-137

**Summary:**

Creative work on text tasks contributes to the greatest extent to increasing the general and elementary mathematical competence of students, to the development of their creative abilities and logical thinking. **Creative exercises** are extremely suitable for stimulating students' mathematical and creative thinking.

In the article, we consider some good practices and solutions of the author teams of the 4th grade mathematics textbooks on the problem. The presented thematic developments are related to the creative work on text tasks of the fourth graders for composing and solving text tasks of different nature. The importance of the topic is in the context of achieving the goals of mathematics education.

**11. Aleksieva, K.** Studying word problems in indirect form in third grade. Yearbook of "Konstantin Preslavsky" University of Shumen, Faculty of Pedagogy, University Publishing

**Summary:**

The study of text tasks expressed in an indirect form contributes to a more comprehensive perception of the condition of the task with its connections and dependencies, the possibilities for transforming ordinary text tasks are enriched, which affects the mental activity and creative imagination of children. Experience shows that solving the same task in several ways, transforming the task, composing different tasks based on the same data, give a much greater effect than solving a large number of tasks of the same type. That is why it would be good if in the teaching content for the third grade indirect tasks are not introduced incidentally and uniformly, but in an appropriate systematic and consistent manner, with the corresponding methodological guidelines for work.

The article analyzes the methodological approaches applied by the author teams of the current textbooks for the 3rd grade of 4 publishing houses when introducing and studying indirect text tasks.

Two author's options are also offered for third-graders' accessible graphical representation using Euler-Venn diagrams, arrows, graphic symbols, and relationships.

**12. Aleksieva, K., Ya. Ruseva.** Games with mathematical content for children with special educational needs according to the method of M. Montessori. UPH "K. Preslavsky", Varna, In: Education and qualification of pedagogical personnel. Applied-practical aspects. Part one, 2020, ISSN 1314-300X, pp. 329-345

**Summary:**

In the article, we present a built system of various games with a mathematical orientation, in accordance with the Montessori methodology for mastering the necessary skills in children with special educational needs. In addition to the detailed methodological options in the games, a comprehensive observation of socialization, communication and the impact on the mathematical, sensory and object manipulative development of children aged 7 to 10 years was carried out.

**13. Aleksieva, K.** Computational tasks in text form in the mathematics curriculum in primary classes. On text assignments in elementary school math course books. (Regarding the word problems in the teaching content of mathematics in primary grades). SocioBrains, www.sociobrains.com, Bulgaria, Issue 65, January 2020, pp. 30-42, 2020, ISSN 2367-5721 (online) (in Bulgarian)

**Summary:**

A special place in the mathematics curricula for grades 1-4 is devoted to the ability to solve text problems, as well as the ability to model situations (compose text problems), to extract information from different sources and use it, transformation of text problems, applying problem solving in practice, etc. This is reflected in the objectives set out in the syllabus for each grade, as well as in the content covered in *Modeling*. The article provides a detailed analysis of the author's decisions regarding text math problems and creative exercises related to text math problems included in the current course books. An emphasis is placed on good methodological decisions of the authors regarding the tasks and exercises for supplementing, transforming and compiling text math problems by the students using given information, independently collecting numerical information from various sources (reference books, encyclopedias, information boards, road maps, timetables, Collected Papers of the Travelling Seminar "Innovations in education", price lists, etc.) included in the different course books.

**14. Aleksieva, K.** Continuity between preparatory groups in kindergarten and first grade. UPH "K. Preslavsky", In: Challenges to competence-oriented education, Shumen, 2020, ISBN 978-619-201-436-0, pp. 96-104

**Summary:**

The problem of achieving continuity in the educational process between the last group of kindergarten and first grade is a priority for any educational reform. It is gaining particular relevance now, when the theoretical statements about the essence and specificity of preschool education take on a new meaning, about the relationship and perspective between the main components of the educational process, namely: *goals and tasks, educational content, methods, concepts and principles, organizational forms and means of training* .

The problem of the mathematical preparation of seven-year-old children for school affects the future intellectual potential of our country. In this aspect, our task is to stimulate, motivate, develop children's curiosity and interest in mathematics.

**15. Aleksieva, K.** Examining the level of mathematical knowledge and skills of first graders (diagnostic toolkit). Faber Publishing, 2019, pp. 174-180, ISBN 978-619-00-0996 (in Bulgarian)

**Summary:**

The article presents a diagnostic toolkit developed by the author for testing the mathematical knowledge, skills and attitudes of first graders. Eight indicators are identified: 1. Children's knowledge of quantities, numbers and ratios; 2. Knowledge of numbers and skills for writing them; 3. Comparing quantities and numbers; 4. Knowledge of arithmetic addition and subtraction; 5. Knowledge of geometric shapes; 6. Knowledge and skills about spatial relations; 7. Knowledge and skills of measurement and units of measurement; 8. Solving logical problems.

The proposed diagnostic test to study the mathematical knowledge and skills of 6-7-year-olds was approbated in real learning environment in May (2016/2017), at the end of the pre-school group and at the beginning of the first grade in September / October, 2017/18 and 2018/19 school years.

Prepared by:.....  
/Kalina Ivanova Aleksieva/