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DEVELOPMENT OF FUNCTIONAL LITERACY THROUGH MATHEMATICAL COGNITIVE ACTIVITY AND GAMES TO ENHANCE SCHOOL READINESS

A B S T R A C T

of a doctoral dissertation

for the award of the educational and scientific degree of **“Doctor”**

in the field of higher education: 1. Pedagogical Sciences

professional field: 1.2. Pedagogy

doctoral programme: Preschool and Primary School Pedagogy

Scientific adviser: Assoc. Prof. Dr. Krasimira Dimitrova

Burgas, 2026

The dissertation was discussed and directed for defence at a meeting of the departmental council of the Department of “Pedagogy of Education”, Faculty of Social Sciences, Burgas State University “Prof. Dr. Assen Zlatarov”, held on 08.04.2026.

The dissertation “Development of Functional Literacy through Mathematical Cognitive Activity and Games to Enhance School Readiness” contains 227 pages, of which 183 pages in the main body and 44 pages of appendices. The text includes: 19 tables, 27 diagrams, 4 figures. The bibliography contains: 91 sources, of which: 73 in Cyrillic, 18 in Latin, including electronic references. The list of the author's publications on the dissertation topic comprises 6 titles.

The defence of the dissertation will take place on 14.07.2026 at 11:30 in Conference Room 220, Faculty of Social Sciences.

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GENERAL CHARACTERISTICS OF THE DISSERTATION THESIS

Relevance of the Problem

In the context of a rapidly developing information society and dynamic social change, functional literacy is becoming a key indicator of educational quality and a prerequisite for successful personal fulfilment. The ability to understand, make sense of, and apply acquired knowledge in real-life situations is the primary condition for the individual's full participation in social life.

The development of functional literacy in preschool age is of particular importance, as this is when the foundations of the child's cognitive, communicative, and social skills are laid. At this stage, the abilities for observation, comparison, classification, logical thinking, and problem-solving are formed – skills directly linked to the development of mathematical literacy as part of functional literacy.

Mathematical cognitive activity, when organised in the form of play, stimulates active thinking, independence, and creative initiative in the child. Through play-based methods, a smooth transition from spontaneous cognition to conscious learning is achieved, combining the cognitive and emotional aspects of development. In this way, play becomes not only a natural form of activity but also an effective tool for enhancing school readiness.

The relevance of the study is grounded in national and European educational priorities aimed at raising the level of functional literacy among children and students. International comparative studies (PISA, TIMSS, PIRLS) show that difficulties in applying mathematical knowledge in practice begin as early as the early stages of education. This necessitates the search for new methodological approaches that combine play activity with cognitive development.

The present study is significant both in theoretical and practical terms, as it proposes a model for developing functional literacy through mathematical cognitive activity and didactic games. It aligns with the goals of the National Strategy for the Development of Preschool and School Education, which emphasises the development of competencies for learning, creativity, and independence from an early age.

Development of functional literacy through mathematical cognitive activity and games to enhance school readiness

Object, Subject, Aims and Objectives of the Dissertation

The object of the experimental study is the process of mathematical preparation in the context of developing functional literacy and preparing preschool-age children for school.

The subject of the experimental study is the influence of mathematical cognitive activity and games on the development of functional literacy and school readiness of preschool-age children.

The main aim of the present study is to examine how mathematical cognitive activity and games can contribute to the development of functional literacy in children and enhance their school readiness.

The objectives of the experimental study are:

1. To review, analyse, and describe the literature related to the dissertation: an overview and interpretation of theoretical and empirically derived theories on functional literacy as a pedagogical construct, with emphasis on its significance for the development of children's cognitive abilities and its educational projections through mathematical cognitive activity and games; theoretical and empirically proven concepts for the development of functional literacy through mathematical cognitive activity and games as an innovative approach to enhancing school readiness, focusing on the educational potential of these methods for stimulating cognitive and socio-emotional development in children.
2. To create a pedagogical model: development of a methodological toolkit for measuring the level and characteristics of functional literacy in preschool-age children at the beginning and end of the experimental activity involving mathematical cognitive activity and games; development of a pedagogical model with the necessary materials and resources for mathematical cognitive activity through games and the use of information technologies to develop functional literacy in preschool-age children, and its piloting in a real educational setting.
3. To organise and conduct experimental work in four main stages: Preparatory stage – preparation of the diagnostic procedure, model, resources, and organisation; Ascertaining stage – baseline diagnostics; Formative stage – piloting of the pedagogical model for mathematical cognitive activity and games; Control stage – final diagnostics, analysis and corrections.

Research Questions and Hypotheses

The formulated research questions derive directly from the theoretical analysis conducted in Chapter One and reflect the main problem areas identified therein. The theoretical review established that functional literacy in preschool age is insufficiently studied in the context of mathematical cognitive activity and play-based approaches, that the concept of school readiness is interpreted inconsistently in pedagogical practice, and that the potential of modern educational technologies in early childhood remains largely unexploited. These findings necessitate empirical verification and set the framework for the following research questions.

The study focuses on the following research questions:

- What are the main prerequisites for the development of functional literacy in preschool-age children in the process of preparing them for school?
- What are the characteristics and specifics of the manifestations of functional literacy in preschool age?
- How can mathematical cognitive activity and play-based approaches support and stimulate the development of functional literacy and school readiness?
- What are the possibilities and prospects of the "MONITI" model (Mathematics, Environment/Society, Nature, Information Technologies, Games/Play) for the effective development of functional literacy in preschool-age children?

In accordance with the aim and objectives of the study, the following main hypothesis has been formulated: The application of the "MONITI" pedagogical model (Mathematics, Environment/Society, Nature, Information Technologies, Games/Play) leads to an increase in children's functional literacy, improves their school readiness, and develops their ability to understand, interpret, and apply information in various contexts. For the statistical verification of the hypothesis, the following null and alternative hypotheses have been formulated:

- Null hypothesis (H_0): The application of the "MONITI" pedagogical model does not lead to statistically significant differences between the Experimental Group (EG) and the Control Group (CG) with respect to children's functional literacy and school readiness.
- Alternative hypothesis (H_1): The application of the "MONITI" pedagogical model leads to statistically significant differences between the Experimental Group (EG) and the Control Group (CG) with respect to children's functional literacy and school readiness.

Structure and Volume of the Dissertation

The dissertation consists of an introduction, three chapters, a conclusion, a bibliography, a list of the author's publications on the topic, thirty-eight appendices. Its volume is 180 pages, not including the appendices. The work includes perspectives for future development, main contributions of the dissertation, a declaration of originality, and participation in research projects.

Chapter One, "Theoretical Foundations of the Dissertation", analyses pedagogical and scientific-methodological literature relating to the historical aspects of mathematical preparation in preschool and primary school age, the nature of functional literacy and mathematical competence, school readiness in its complex character, the possibilities for developing functional literacy through mathematical cognitive activity and games, as well as the role of modern information and educational technologies in preschool and primary education.

Chapter Two, "Research Design", presents the concept of the experimental study – the object, subject, aim, objectives, research questions, and hypothesis. It describes the methodology and organisation of the study, the sample and research groups, the criteria and indicators for evaluation, the stages and duration of the experimental work, and the developed "MONITI" pedagogical model.

Chapter Three, "Results and Analyses from the Experimental Work", presents the results from the four stages of the experimental work. The organisational stage includes the development of the diagnostic toolkit, the model, and establishing contact with educational institutions. At the ascertaining stage, a survey of 328 educational specialists was conducted, along with baseline diagnostics with children from both groups. At the formative stage, the "MONITI" pedagogical model was piloted through a system of thematically organised pedagogical situations, play activities, and educational technologies. The control stage includes final diagnostics and comparative analysis of the results, which establishes a statistically significant difference between the Experimental Group and the Control Group in favour of the EG.

The Conclusion presents the results achieved and confirms the research hypothesis that the application of the "MONITI" pedagogical model leads to a statistically significant increase in functional literacy, mathematical competence, and school readiness of preschool-age children. The main contributions of the dissertation and perspectives for future development of the model are formulated.

BRIEF SUMMARY OF THE DISSERTATION THESIS

CHAPTER I. THEORETICAL FOUNDATION

The historical aspects of mathematical preparation in preschool and primary school age are examined on the basis of the periodisation proposed by K. Dimitrova (2010), which traces the development of mathematics education in Bulgaria from the most ancient period to the present day. D. Galabova (2009) emphasises that mathematical knowledge in kindergarten is built on the visual-practical and visual-imaginative basis of thinking and gradually transitions towards elements of abstraction. The author regards cognitive mathematical activity as a system of mental operations with a universal character, including operations such as observation, analysis, comparison, classification, seriation, and generalisation. Galabova notes that the system of logical techniques has an internal structure and sequence – mastery of each subsequent technique is only possible once prior skills have been acquired, which is why the teacher must plan education purposefully to ensure a smooth transition from external actions with objects to internal mental operations (Galabova, 2009, pp. 53–54).

Functional literacy is examined as the central concept of the study on the basis of the conceptions of several authors. Yermolenko (2015) defines functional literacy as integrative education whose content changes depending on social realities. The author emphasises that functional literacy represents the lowest, yet obligatory, level in the hierarchy "literacy–education–competence–culture" and is the foundation upon which higher forms of knowledge and competence are built. In a similar vein, Maneva (2023) emphasises that functional literacy is inextricably linked to the development of key competencies and critical thinking – it is not reduced to the acquisition of facts, but requires the ability to understand, apply, and transform them in various contexts, thereby providing the link between education and competence and enabling children and students to turn knowledge into action.

The normative framework of the study is based on Ordinance №5 of 2016 on preschool education, which defines mathematical cognitive activity as the primary mechanism for building mental operations and developing the cognitive activity of the child. According to the requirements of the ordinance, by the end of the fourth group, children should possess skills for counting and understanding numerical relations up to 10, recognising and using geometric shapes, orienting in spatial and temporal relations, skills for comparison, seriation, and classification, awareness of regularities in the environment, and application of mathematical knowledge in play and practical activities. Ordinance №5 of 2015 on general education preparation, in turn, defines mathematical competence as key to the personal development and social realisation of students.

Play as the leading activity in preschool age is examined on the basis of the conceptions of A. Veleva (2013), El. Georgieva (2022), and D. Dimitrov (2009). Veleva defines play as a universal mechanism for the integration of the child's cognitive, social, and emotional growth and proposes a classification that includes folk games, role-play, dramatisation games, construction games, autodidactic games, outdoor games, and computer games. The author emphasises that through play, individual growth is stimulated, character is formed, and the child's life experience is enriched, as play simultaneously fulfils a cognitive, educational, socialising, emotional, developmental, and creative function (Veleva, 2013). Elena Georgieva proposes a modern systematised classification that distinguishes four main groups – creative games, rule-based games, autodidactic games, and digital games – with emphasis on the functional link between play and developmental stages and its pedagogical orientation (Georgieva El., 2022).

School readiness is examined on the basis of the conceptions of several authors, among whom D. G. Dimitrov (2011) emphasises that school readiness is not a one-time achievement, but the result of a long process of development and pedagogical influence that begins in early childhood. The author regards readiness as a multi-dimensional phenomenon, encompassing psychological, intellectual, emotional-volitional, personal, and social readiness, with emphasis on the role of mathematical cognitive activity in stimulating analytical thinking and cognitive activity. He argues that school readiness is the result not so much of the accumulation of knowledge as of the development of the ability to learn – the ability to understand a task, plan an action, seek a solution, and evaluate the result (Dimitrov D., 2011).

Bizhkov systematises readiness into five equal areas and emphasises that it is the result of the child's overall development, and that diagnostics aims to identify those qualities of the child's personality that are decisive for successful adaptation to school requirements (Bizhkov et al., 2014). E. Dragolova regards school readiness as a dynamic state reflecting the unity of cognitive, social, emotional, and physical development, and includes six interrelated components – intellectual, motivational, emotional-volitional, social-moral, personal, and physical readiness (Georgieva-Dragolova, 2024).

The digital competence of teachers is analysed on the basis of the European DigCompEdu Framework (2017), which encompasses six areas – professional engagement, use of digital resources, teaching and learning, assessment, empowering learners, and fostering learners' digital competence. The framework defines digital competence as a key element of the professional profile of the modern teacher and a guarantee of quality education in the digital age.

Modern information and educational technologies are examined as a key factor in the transformation of the educational process in preschool and primary school age. K. Dimitrova (2024, 2025) emphasises that digitalisation opens up possibilities for personalising learning, integrating interdisciplinary approaches, and developing critical thinking and creativity. The application of information technologies in early education contributes to the formation of initial skills for mental operations, stimulating cognitive abilities, and building initial information literacy skills (Tuparova & Kaseva, 2016). R. Papancheva (2022) emphasises the role of virtual and augmented reality as modern educational technologies that expand the possibilities of traditional teaching by creating a rich, interactive, and immersive educational environment leading to increased motivation for learning. Papancheva and Dermenzhieva (2023) also address artificial intelligence in education, emphasising the importance of clear normative and ethical regulation to ensure that the human factor remains primary and that artificial intelligence is used for meaningful, constructive, and developmentally sound educational purposes. Within the framework of the study, the types of digital and programmable devices, desktop and online applications, virtual and augmented reality, as well as artificial intelligence solutions in education, are examined.

Conclusions form Chapter One

The theoretical analysis of key concepts and conceptions related to the historical aspects of mathematical preparation in preschool and primary school age, the role of play as a leading activity in childhood, functional literacy, and school readiness, provides grounds for formulating several significant generalisations. The historical overview shows that the development of mathematics education in early childhood is the result of deliberate pedagogical evolution, in which scientifically grounded approaches adapted to the age-specific characteristics and cognitive abilities of children have gradually been established.

The views of leading pedagogues and psychologists examined prove that play has a key role in the overall development of the personality in early childhood. It is established as the primary mechanism for cognition, social adaptation, emotional development, and creativity, making it an indispensable pedagogical tool in preschool and primary education.

The central concept of the dissertation study is functional literacy, regarded as an integrative characteristic of the personality linked to the ability to successfully apply knowledge and skills in a variety of life situations. The analysis shows that the formation of functional literacy is directly connected to the active participation of the child in meaningful activities such as play, cognitive-investigative activity, and practical activity.

The theoretical propositions examined regarding school readiness outline its complex character, encompassing cognitive, social, emotional-volitional, and personal maturity. The interrelation between play activity, the development of cognitive abilities, and the building of intrinsic motivation for learning as prerequisites for successful adaptation to the school environment is emphasised.

Of particular importance in the theoretical analysis is the examination of modern information and educational technologies. These are established as an important factor in enriching the educational environment, increasing motivation for learning, and creating conditions for individualising and personalising the educational process. Digital devices, online platforms, interactive resources, as well as virtual and augmented reality technologies, and artificial intelligence solutions, expand the teacher's possibilities, support the development of key competencies, and make a significant contribution to the modernisation of the educational process in preschool and primary school age.

In summary, the theoretical analysis in Chapter One creates a solid scientific foundation for the dissertation study, arguing the significance of play as a pedagogical resource, outlining its role in the development of functional literacy and school readiness, and highlighting the possibilities and challenges associated with modern educational technologies. These conclusions prepare the groundwork for the subsequent empirical study and for formulating pedagogical solutions aimed at optimising the educational process in the context of the modern digital educational environment.

CHAPTER II. RESEARCH DESIGN

Methodology and Organisation of the Study

The present study is based on a mixed methodology combining quantitative and qualitative methods for collecting, processing, and analysing empirical data. Quantitative methods – diagnostic tests, surveys, and statistical processing – allow for objective measurement of results and verification of the research hypothesis. Qualitative methods – pedagogical observation, interview, and expert assessment – provide contextual information about the behavioural, motivational, and social manifestations of the children. The two types of methods function in logical interdependence, which increases the validity and reliability of the study. The leading research method is the pedagogical experiment, implemented in four successive stages.

Organisation of the Study

The study was conducted in five educational institutions from different localities: a regional city, a large city, and a small town, ensuring representativeness of the sample. Prior to the start, official permission was obtained from the directors, and the distribution of institutions into the two groups was done by institution, not individually by children.

The Experimental Group (EG) includes a primary school in a regional city, a kindergarten and a primary school in a small town – a total of 108 children from preparatory groups and first grade. The Control Group (CG) includes a kindergarten in a regional city and a secondary school in a large city – a total of 70 children.

The teachers from the Experimental Group were familiarised with the "MONITI" model at working meetings during the course of the study, which ensured the necessary methodological consistency. The baseline and final diagnostics were conducted personally by the researcher at all institutions, which guarantees standardisation of conditions and objectivity of results.

Criteria and Indicators of the Study

In the present study, the criteria for evaluation and analysis are structured around two main aspects – criteria relating to the children, and criteria relating to the pedagogical activity of the teachers.

Based on this two-directional structure, criteria relating to children in the fourth group of kindergarten and first-grade students are denoted by the letter “S”, while criteria and indicators relating to teachers are denoted by the letter “T”.

Table 1. Criteria and Indicators

Criterion	Indicators
S1: Play activity	S1.1 Follows and observes the rules of play; S1.2 Actively participates in games; S1.3 Shows independence and initiative; S1.4 Contributes to group play.
S2: Mathematical competence (Kindergarten)	S2.1.1 Counts to ten; S2.1.2 Determines the ordinal position of an object; S2.1.3 Arranges objects by attribute; S2.1.4 Arranges by height/length/width; S2.1.5 Determines spatial relations; S2.1.6 Determines mutual positioning; S2.1.7 Knows days/months/seasons; S2.1.8 Matches objects to geometric shapes; S2.1.9 Follows logical sequences.
S2: Mathematical competence (1st grade)	S2.2.1 Knows numbers to 10; S2.2.2 Counts forward and backward; S2.2.3 Compares quantities; S2.2.4 Recognises geometric shapes; S2.2.5 Spatial orientation; S2.2.6 Arranges by given attributes.
S3: School readiness (Kindergarten)	S3.1.1 Manages readiness tests; S3.1.2 Shows interest in cognitive activity; S3.1.3 Follows rules and instructions; S3.1.4 Works in a team.
S3: School readiness (1st grade)	S3.2.1 Applies knowledge in new contexts; S3.2.2 Shows motivation for learning; S3.2.3 Works in a team.
S4: Functional literacy (Kindergarten)	S4.1.1 Understands and uses information; S4.1.2 Applies knowledge in problem-solving; S4.1.3 Independent thinking and analysis.
S4: Functional literacy (1st grade)	S4.2.1 Extracts information from various sources; S4.2.2 Applies knowledge in new contexts; S4.2.3 Logical thinking and classification.
T1: Organisation of play activity	T1.1 Creates and applies age-appropriate games; T1.2 Organises cooperative group games.
T2: Frequency of play activities	T2.1 Uses games with high frequency; T2.2 Includes various types of games.
T3: Digital competence	T3.1 Uses digital resources; T3.2 Applies interactive technologies; T3.3 Works with programmable devices; T3.4 Readiness for self-directed learning.
T4: Pedagogical concepts	T4.1 Understands the role of functional literacy; T4.2 Understands the role of school readiness.

Experimental Word

The study was implemented through a pedagogical experiment in four successive stages.

Stage One – Preparatory (June–September 2024)

This stage has an organisational character and includes the development of the diagnostic toolkit and the “MONITI” model, establishing contact with educational institutions, formulating the criteria and indicators, and defining the time frame.

Stage Two – Ascertaining (October–December 2024)

This stage aims to establish the baseline level of the studied indicators. An original diagnostic toolkit was developed, comprising three worksheets with 8 tasks each, structured according to the educational areas of “Quantitative Relations”, “Spatial Relations”, and “Geometry”. The maximum total score is 72 points. A survey was also conducted among 328 educational specialists using two questionnaires – on the understanding of functional literacy and play-based approaches, and on school readiness.

Stage Three – Formative (December 2024–April 2025)

This stage is aimed at piloting the “MONITI” pedagogical model through role-playing games, mathematical storylines, didactic and logical activities, problem-exploration methods, and an interactive educational environment with digital resources and programmable devices.

Stage Four – Control (April–September 2025)

This stage includes final diagnostics with variations of the tasks from the baseline test, statistical processing of data using descriptive statistics and Student's t-test at a significance level of $p \leq 0.05$, correlation and regression analysis, qualitative analysis through expert assessment and interview, and formulation of conclusions regarding the effectiveness of the model.

Description of the “MONITI” Model

The “MONITI” model is an integrative pedagogical model with a developmental character, aimed at fostering functional literacy, developing mathematical competence, and supporting the school readiness of preschool and primary school-age children. The name is an acronym denoting the main content components: Mathematics, Environment/Society, Nature, Information, Technologies, Play (in Bulgarian: Matematika, Okolen svyat/Obshtestvo, Nauka, Informatsionni Tekhnologii, Igra).

The model is based on three leading principles – play-based learning, the competency-based approach, and the constructivist educational paradigm. Play is not used as a supplement to education, but as its primary form. Mathematical tasks are presented as challenges within the storyline, and their solution is meaningful and motivated by the play situation. The competency-based approach is realised through the orientation of all activities towards building skills for applying knowledge in diverse practical contexts. The constructivist paradigm finds expression in situating all tasks in contexts familiar to the child from everyday life, such as: family, shop, nature, holidays, caring for animals.

Structurally, the model is realised through thematically organised pedagogical situations centred on the heroine Moniti – a character created with artificial intelligence, with various emotional states and seasonal outfits. The tasks are aimed at developing quantitative representations, counting and comparing, classifying, arranging and discovering regularities, forming spatial representations, recognising geometric shapes, developing logical thinking, as well as geometric transformations (symmetry, translation, and rotation). The model also incorporates digital resources and programmable devices for developing initial skills of logical and algorithmic thinking.

The model has been developed for application both in the fourth preparatory group of kindergarten and at the beginning of first grade. As an additional resource, an e-book has been developed, including descriptions of games for enhancing mathematical competence, functional literacy, and school readiness.

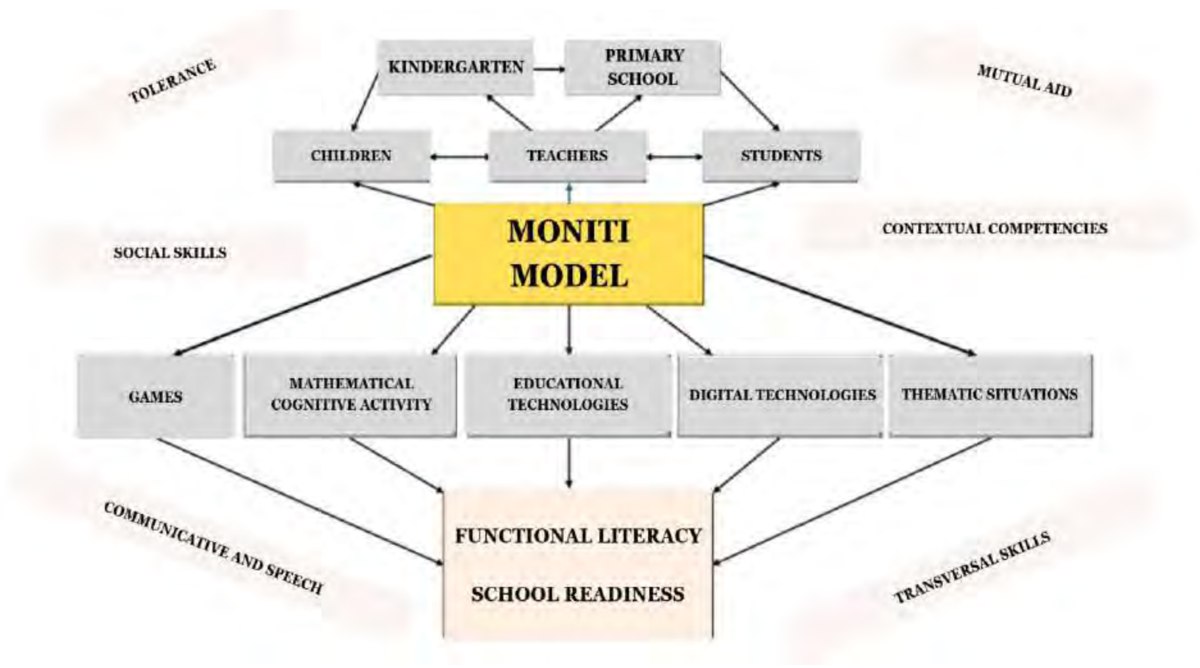

Figure 1. The "MONITI" Model

CHAPTER III. RESULTS AND ANALYSES

Instruments Used

For the processing and analysis of empirical data, a complex of quantitative and qualitative methods was used. Quantitative methods include descriptive statistics – mean values, percentage distributions, and frequency analysis, correlation and regression analysis, and Student's t-test for establishing statistically significant differences between the results of the baseline and final diagnostics. Statistical processing was performed using the specialised software Jamovi, and Microsoft Excel was used for visualisation. Survey data were also processed using automatically generated summaries in Microsoft Forms.

Qualitative methods include content analysis of open-ended questions from the survey, pedagogical observation, and expert assessment. Pedagogical observation tracks the behavioural and cognitive manifestations of children during play and educational activities. Expert assessment is carried out by educational specialists who describe the children's manifestations according to predetermined criteria. The combination of quantitative and qualitative methods ensures a more complete and objective study.

Stages of the Experimental Word

Ascertaining Stage

The ascertaining stage includes two interrelated components: a survey of educational specialists and baseline diagnostics with the Experimental Group and the Control Group. The two components were implemented sequentially and in interrelation – the survey establishes the actual state of educational practice and the needs of educational specialists, while the baseline diagnostics establishes the children's entry level on the studied indicators.

The survey was conducted through two online questionnaires created in MS Forms (Figures 2, 3), in which 328 educational specialists from across the country participated. The questionnaires cover closed and open-ended questions, structured according to the developed criteria and indicators, and collect information on the frequency and types of play activities, the availability of resources, the use of digital technologies, and the understanding of key pedagogical concepts. Demographic data are also included, enabling more precise analysis of the relationships between the work context and the attitudes of educational specialists.

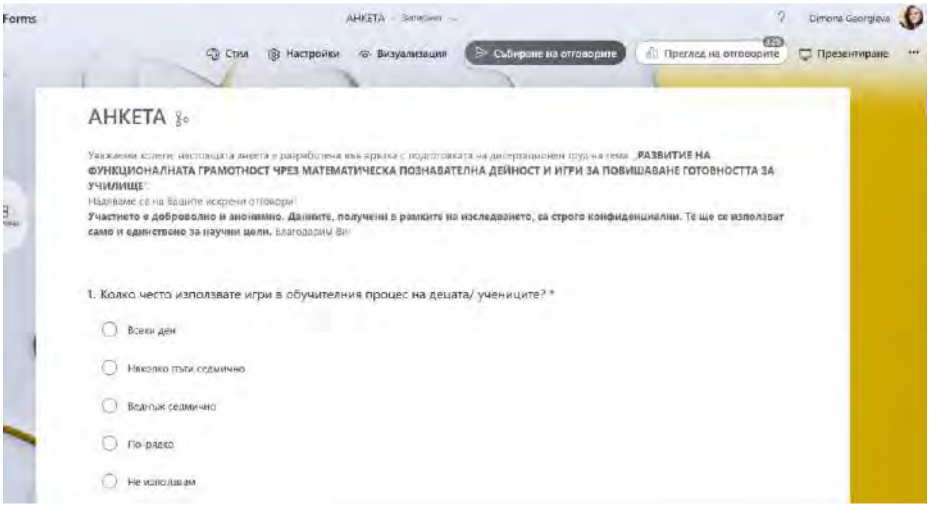

Figure 2. Questionnaire №1, created in MS Forms

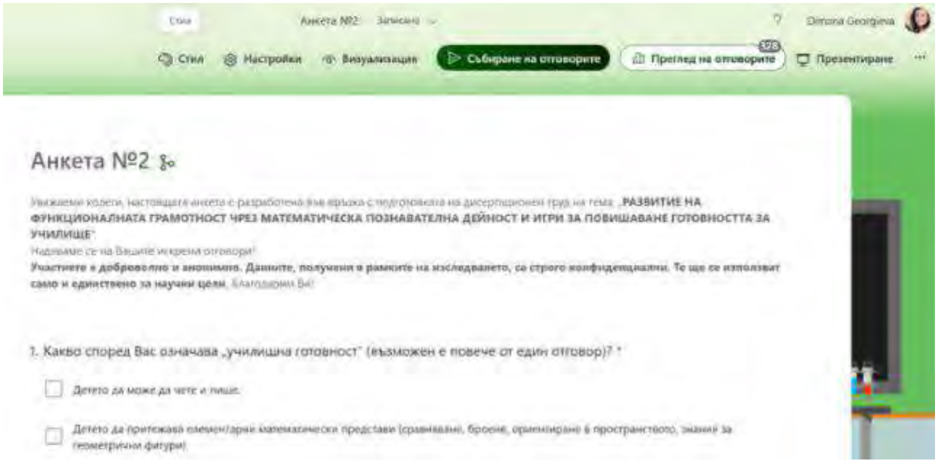

Figure 3. Questionnaire №2, created in MS Forms

Results were analysed according to four criteria. According to Criterion T1 (Organisation and pedagogical leadership of play activity), the data show that 78% of respondents develop additional educational resources (Diagram 1), which is an indicator of high professional engagement. The self-assessment of the developed resources (Table 2) reveals that for most indicators the assessment "average" predominates, with only the indicator "Working with digital technologies" dominated by the assessment "low" (46.1%), pointing to the need for additional support in this area.

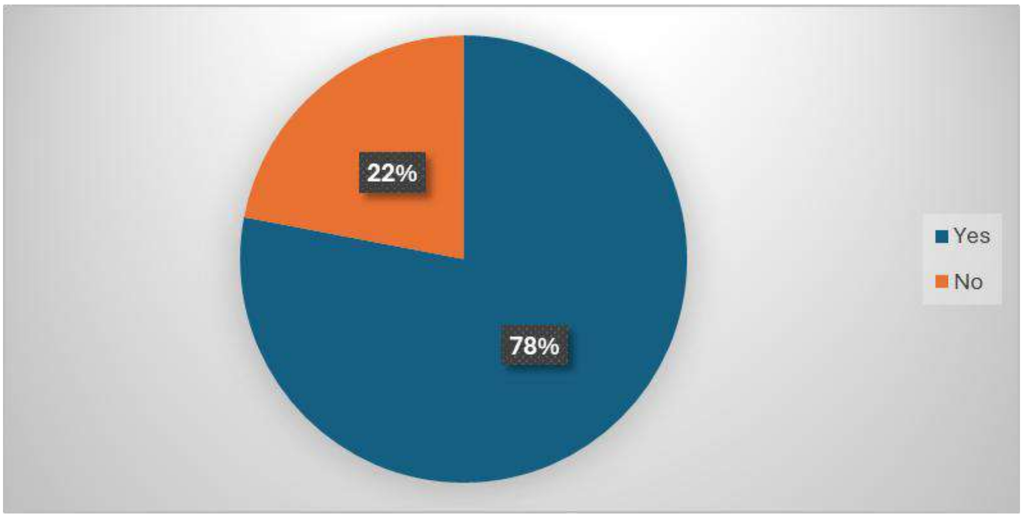

Diagram 1. Do you develop additional educational resources and games for the children/students?

Table 2. Assessment of Developed Resources

Indicator	**Very High**	**High**	**Average**	**Low**	**Cannot assess**
Practical applicability of knowledge and competences	19.5%	23.3%	53.7%	0.4%	3.1%
Independence of children/students	11.3%	36.3%	51.2%	1.2%	0%
Differentiation according to each student/child's progress	7.4%	36.2%	47.9%	3.9%	4.7%
Transfer of knowledge and skills to other subject areas	13.7%	36.3%	47.3%	1.2%	1.6%
Working with digital technologies	16.8%	30.1%	4.7%	46.1%	2.3%

According to Criterion T2 (Frequency and purposefulness of using play activities), the results show a high frequency of game use – 38% of teachers use them every day, and 36% several times a week (Diagram 2). Digital and outdoor games are the most preferred (28%), followed by role-playing games (24%) and board games (17%) (Diagram 3). Despite positive attitudes, 47% of respondents encounter difficulties in applying games, with the main barriers being a shortage of time, lack of resources, and insufficient methodological framework. Only 37% have full resource support, while 93% express a desire for developed resources to facilitate the organisation of play activities. Priority needs are physical materials and digital applications, cited by 30% of participants each, followed by methodological guidelines (19%) and additional training (18%).

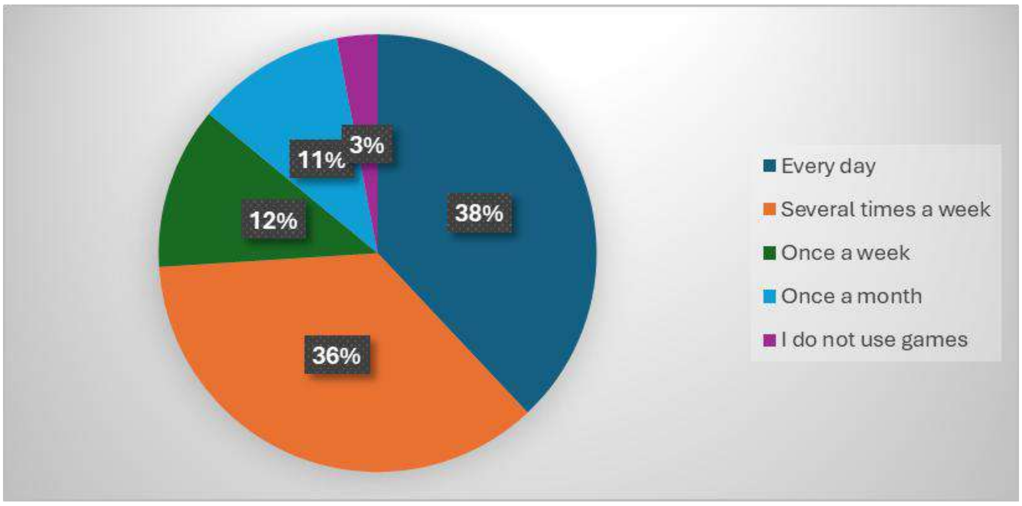

Diagram 2. Percentage distribution of the frequency of game use in the educational process

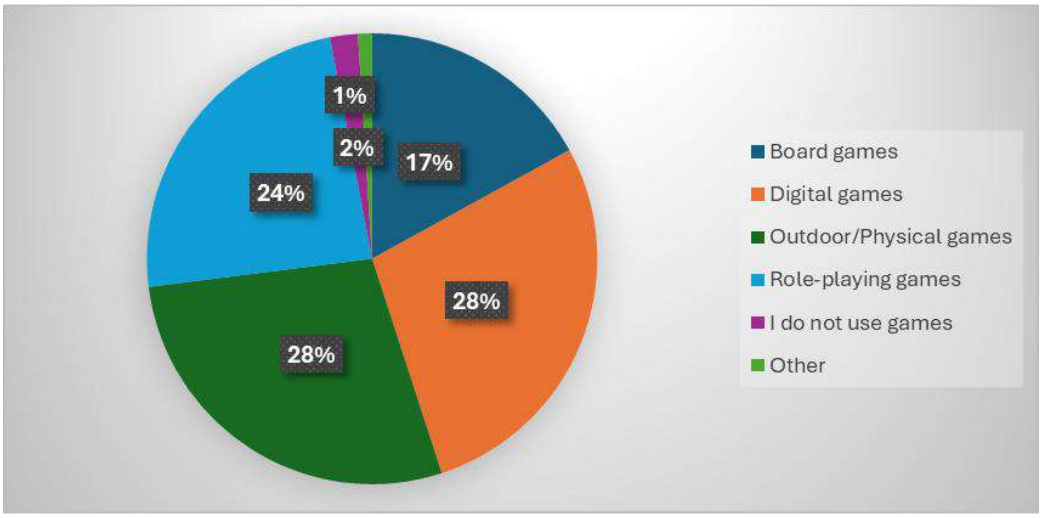

Diagram 3. What types of games do you use most often? (More than one answer is possible.)

According to Criterion T3 (Digital competence), 79% of respondents consider the use of information technologies an advantage in developing functional literacy, and 72% actively apply them in their practice. Among the most widely used are the interactive whiteboard (40%), LearningApps (25%), Kahoot (20%), and Wordwall (15%). Programmable devices are used by only 25% of teachers, with Bee-Bot being the most widespread (52% of those using programmable devices), followed by Ozobot, Photon, and Micro:bit. The low rate of use of programmable devices is associated with a lack of material resources, insufficient qualifications, and limited access to training.

According to Criterion T4 (Understanding of basic pedagogical concepts), the analysis shows that 58% of teachers associate functional literacy with the application of knowledge in real situations, 13% with social and communicative skills, and 11% with critical thinking, while 18% have an incomplete understanding of the concept. When asked whether games can improve functional literacy, 86% answered affirmatively (Diagram 4), with the most strongly developed aspects being teamwork skills (29%), problem-solving (27%), and communicative skills (24%). Regarding school readiness, respondents associate it primarily with skills for concentration and following instructions (23%) and social adaptation (23%), with 11% associating it with reading and writing skills – a result interpreted as an expression of inflated expectations from preschool age. Only 43% consider that kindergarten activities sufficiently prepare children for first grade, 43% note that preparation is partial, and 14% of respondents consider preparation insufficient (Diagram 5). In a subsequent question, 65% assessed cooperation between kindergarten and primary school as insufficient or practically non-existent. As the main necessary change, 51% indicate the introduction of uniform criteria for school readiness.

The results obtained reveal a contradiction between the positive attitudes of educational specialists towards play-based approaches and the actual difficulties in their application, conditioned by a lack of resources, time, and methodological support. The tendency towards a discrepancy between the demands on children upon entering first grade and the goals of preschool education is also confirmed. These data not only describe the existing difficulties but also justify the conceptual orientation of the "MONITI" model – its emphasis on play-based approaches, mathematical content, digital technologies, and continuity between the two educational stages.

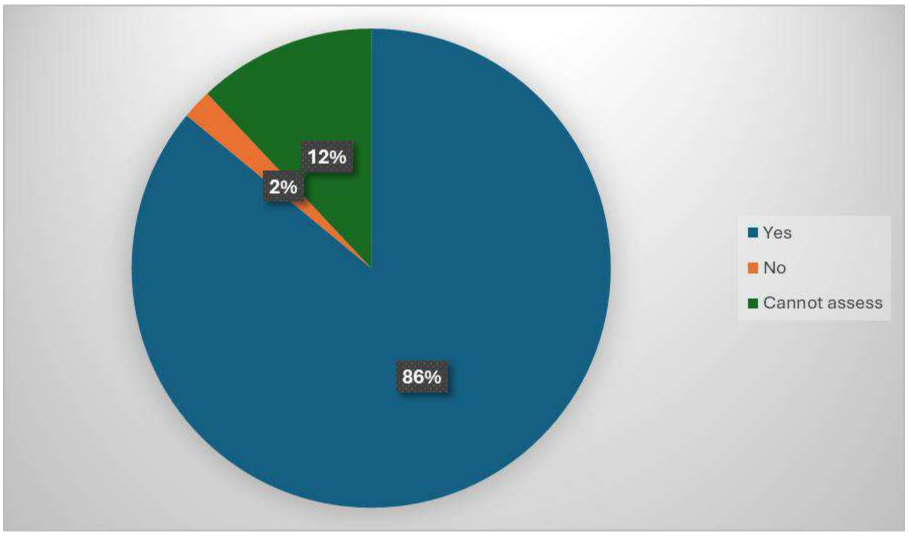

Diagram 4. Do you think that the use of games in the educational process can significantly improve the functional literacy of children/students?

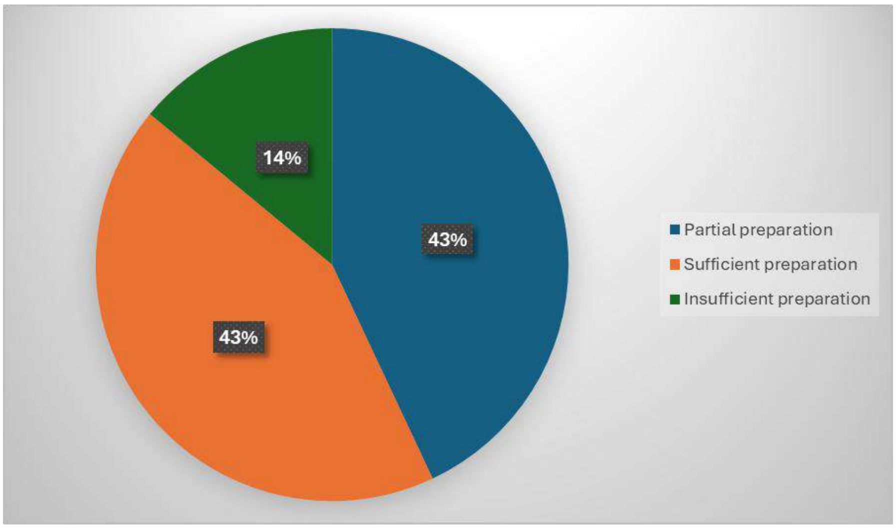

Diagram 5. Do you think that the activities in kindergarten sufficiently prepare children for the requirements of first grade?

In addition to the survey, baseline diagnostics were conducted to establish the entry level of children from the Experimental Group and the Control Group on the studied indicators. The diagnostic toolkit covers three tests relating to quantitative representations, geometry and logic, and spatial orientation, each containing eight tasks, with a maximum of 24 points per test and 72 in total. In order to outline the conceptual framework of the toolkit, an analysis of the tasks in the baseline and final tests was carried out from the perspective of the distinction between mathematical competence (MC) and functional literacy (FL). The analysis shows that the toolkit does not mechanically separate the two areas, but regards them as interrelated: mathematical competence provides the tools, while functional literacy provides the context and application.

Table 3. Analysis of tasks from the baseline test on quantitative representations – Kindergarten

Task	MC	FL	Emphasis
Task 1.	Counting and quantitative comparison	Identification of objects and understanding of instruction	MC
Task 2.	Understanding the ordinal meaning of a number	Understanding and following instructions; awareness of counting direction	MC
Task 3.	Classification by attribute and quantitative comparison	Decision-making in a real context	FL; MC
Task 4.	Quantity-digit correspondence	Orientation in the material world	MC
Task 5.	Seriation by magnitude	Understanding of spatial relation in a real context	MC
Task 6.	Implicit subtraction without formal symbol	Extracting mathematical information from a visual situation	FL; MC
Task 7.	Counting and counting down	Understanding of instruction	MC
Task 8.	Digit-quantity correspondence; Addition	Independent completion of task without visual example; drawing to complete	FL; MC

Table 4. Analysis of tasks from the baseline test on geometry and logic – Kindergarten

Task	MC	FL	Emphasis
Task 1.	Classification by attribute	Understanding of instruction	FL; MC
Task 2.	Geometry, logic	Recognising a regularity and reasoning	MC
Task 3.	Translation in a grid according to a model	Following a visual instruction	MC
Task 4.	Symmetry in a grid without a full model	Independent interpretation of a task without a template	FL; MC
Task 5.	Recognition of a geometric shape; classification	Applying mathematical knowledge in a real context	FL; MC
Task 6.	Geometric transformation (rotation)	Recognising a regularity and reasoning	MC
Task 7.	Logic	Tracing interrelations and applying logical thinking	FL
Task 8.	Rhythm	Understanding rhythmic order and reasoning	FL; MC

Table 5. Analysis of tasks from the baseline test on spatial orientation – Kindergarten

Task	**MC**	**FL**	**Emphasis**
Task 1.	Coordinate grid	Orientation and working with a legend	MC
Task 2.	Spatial relations	Independent determination of a sorting criterion	FL; MC
Task 3.	Spatial relations	Reasoning and logical thinking to solve the task	FL
Task 4.	Spatial relations	Matching verbal instruction to visual situation	FL
Task 5.	Orientation in spatial relations to multiple objects	Evaluation and categorisation in a real situation	FL
Task 6.	Coordinate grid	Simultaneous work with coordinates, colours, and real objects	FL; MC
Task 7.	Maze with code in a square grid	Following instruction to achieve a goal	MC
Task 8.	Positioning objects according to a given legend in a square grid	Understanding, interpreting, and executing a complex coded instruction	FL; MC

Table 6. Analysis of tasks from the final test on quantitative representations – Kindergarten; (baseline for 1st grade)

Task	MC (Mathematical Competence)	FL (Functional Literacy)	Emphasis
Task 1.	Understanding the ordinal meaning of a number	Understanding and following instructions; awareness of counting direction	MC
Task 2.	Grouping by a given attribute; counting	Following an instruction	MC
Task 3.	Counting and quantitative comparison	Identification of objects and understanding of instruction	MC
Task 4.	Quantity-digit correspondence	Orientation in the material world	MC
Task 5.	Seriation by magnitude	Understanding of a spatial relation in a real context	MC
Task 6.	Implicit subtraction without a formal symbol	Extracting mathematical information from a visual situation	FL; MC
Task 7.	Counting and counting down	Understanding and interpreting an instruction	MC
Task 8.	Digit-quantity correspondence; addition	Independent completion of a task without a visual example; drawing to complete	FL; MC

Table 7. Analysis of tasks from the final test on geometry and logic – Kindergarten; (baseline for 1st grade)

Task	MC (Mathematical Competence)	FL (Functional Literacy)	Emphasis
Task 1.	Classification by attribute	Understanding of instruction	FL; MC
Task 2.	Identifying mathematical relationships	Applying knowledge through reasoning	FL; MC
Task 3.	Translation in a grid according to a model	Following a visual instruction	MC
Task 4.	Symmetry in a grid without a full model	Independent interpretation of a task without a template	FL; MC
Task 5.	Recognition of a geometric shape; classification	Applying mathematical knowledge in a real context	FL; MC
Task 6.	Geometric transformation (rotation)	Logical judgement and spatial thinking	MC
Task 7.	Logical exclusion	Tracing interrelations	FL
Task 8.	Rhythm	Understanding rhythmic order and reasoning	FL; MC

Table 8. Analysis of tasks from the final test on spatial orientation – Kindergarten; (baseline for 1st grade)

Task	MC (Mathematical Competence)	FL (Functional Literacy)	Emphasis
Task 1.	Spatial relations	Matching verbal instruction to a visual situation	FL
Task 2.	Spatial relations	Orientation by spatial attributes and logical thinking	FL
Task 3.	Coordinate grid	Simultaneous work with a coordinate system, colours, and real objects	FL; MC
Task 4.	Orientation in spatial relations to multiple objects	Evaluation and categorisation in a real situation	FL
Task 5.	Spatial relations	Understanding of instruction and logical judgement	FL
Task 6.	Maze with code in a square grid	Following an instruction to achieve a real goal	MC
Task 7.	Positioning objects according to a given legend in a square grid	Understanding, interpreting, and executing a complex instruction	FL; MC
Task 8.	Coordinate grid	Simultaneous work with coordinates, colours, and geometric shapes; reasoning	FL; MC

Table 9. Analysis of tasks from the final test on quantitative representations – 1st grade

Task	MC (Mathematical Competence)	FL (Functional Literacy)	Emphasis
Task 1.	Quantity-digit correspondence	Independent completion without a visual model	MC
Task 2.	Counting and recording a digit; comparison sign	Extracting information	MC
Task 3.	Number sequence and order	Logical judgement and recognition of a regularity	MC
Task 4.	Measurement and comparison by magnitude	Reading, recording, and decision-making in a real context	FL; MC
Task 5.	Growing pattern	Continuing a pattern without instruction	MC
Task 6.	Mathematical modelling; writing a numerical expression	Understanding a word problem in a real context and representing it as a numerical expression	FL; MC
Task 7.	Composition of a number	Mathematical thinking in a structured context	MC
Task 8.	Equality of quantities through addition	Applying the concept of balance in a real-life situation	FL; MC

Table 10. Analysis of tasks from the final test on geometry and logic – 1st grade

Task	MC (Mathematical Competence)	FL (Functional Literacy)	Emphasis
Task 1.	Geometric analysis of a complex figure; classification and count by type	Reading a real object as a collection of geometric shapes	MC
Task 2.	Rhythmic sequence	Extracting a rule from observation; reasoning	MC
Task 3.	Geometric transformation (rotation)	Logical completion of the task without verbal explanation from the teacher	MC
Task 4.	Symmetry in a square grid	Abstract operation in a real context	MC
Task 5.	Recognition of a geometric shape	Applying mathematical knowledge in a real context	FL; MC
Task 6.	Logic	Understanding and applying a rule	MC
Task 7.	Geometric shape; counting geometric figures	Identifying patterns in a visual structure	MC
Task 8.	Creating a picture from geometric shapes; quantitative relations	Creative application of mathematical knowledge in independent task completion	FL; MC

Table 11. Analysis of tasks from the final test on spatial orientation – 1st grade

Task	MC (Mathematical Competence)	FL (Functional Literacy)	Emphasis
Task 1.	Composing a route in a square grid	Decoding a colour-coded instruction and applying it step by step	FL; MC
Task 2.	Spatial orientation	Understanding an instruction and orienting in a near-real environment	FL
Task 3.	Spatial orientation	Multi-level interpretation of instructions	FL
Task 4.	Working with coordinates	Orienting by pre-given coordinates; applying knowledge related to geometric shapes	MC
Task 5.	Spatial orientation	Matching a visual situation to a written word	FL
Task 6.	Coordinate grid with spatial prepositions	Identifying a location by multiple attributes	MC
Task 7.	Spatial relations	Transitioning from a real context to an abstract scheme	FL; MC
Task 8.	Spatial relations	Understanding and applying verbal instructions through practical and creative execution	FL; MC

Table 12. Descriptive statistics of baseline test results in EG and CG

	Group	**Baseline Test**
Number of participants (N)	EG	108
	CG	70
Mean	EG	48.1
	CG	48.3
Median	EG	50.5
	CG	50.5
Standard deviation	EG	9.45
	CG	9.10
Minimum	EG	28
	CG	29
Maximum	EG	64
	CG	60

Table 13. Distribution of children by achievement levels on the baseline test

Level	EG (n=108)	%	CG (n=70)	%
Low (0–36 pts.)	15	13.9%	9	12.9%
Average (37–54 pts.)	53	49.1%	36	51.4%
High (55–72 pts.)	40	37.0%	25	35.7%

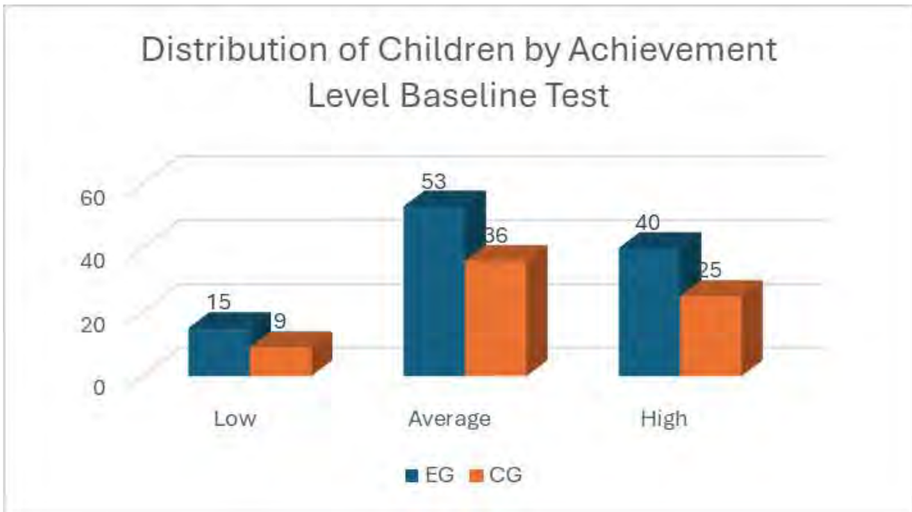

Diagram 6. Distribution of Children by Achievement Level – Baseline Test

Table 14. Results from the independent-samples t-test comparing EG and CG on the baseline test

Independent-samples t-test		t-value	df (Degrees of Freedom)	p (Significance Level)	Mean Difference	Standard Error of Mean Difference	95% Confidence Interval			Effect Size
							Lower Bound	Upper Bound		
Baseline Test	Student's t	-0.142	176	0.887	-0.203	1.43	-3.02	2.62	Cohen's d	-0.0218

For the statistical processing of data, methods of descriptive statistics and an independent-samples t-test were used. The analysis established $t(176) = -0.142$, $p = 0.887$, which confirms the comparability of the two groups at the beginning of the study and creates the conditions for a correct comparison of results after the implementation of the formative stage.

Formative Stage

The formative stage was implemented in the period December 2024 – April 2025 through piloting of the “MONITI” pedagogical model in real educational conditions. Activities were applied both in the fourth preparatory group of kindergarten and in first grade at primary school, and were structured according to three criteria.

Criterion S1: Play Activity

Three types of play activities were implemented. Role-playing games – “Moniti at the Shop” and “Moniti at the Doctor's Office”, through which children take on social roles, apply counting knowledge, and develop communicative skills. Autodidactic outdoor games – “Moniti's Christmas and the Bee”, “Moniti Confused about the Seasons”, “Moniti Learns the Professions”, “Moniti in Environmental Protection”, and “Moniti in the World of Geometry”, implemented as relay activities combining physical activity with cognitive tasks. Construction games – “Kite” and “Bird Feeder”, developing skills for working with geometric shapes, spatial thinking, and fine motor skills.

Criterion S2: Mathematical Competence

Three types of activities were implemented. Thematic pedagogical situations – six thematic situations with the heroine Moniti, three of which implemented via an interactive whiteboard (“Moniti at the Fun Zoo”, “Moniti Goes to School”, “Moniti in the World of Emotions”) and three via worksheets (“Moniti's Birthday”, “Message in a Bottle”, “Visiting Grandma”), covering counting, classification, spatial orientation, and geometric transformations. Activities with geometric shapes – “In the World of Geometry” and “Geometry Comes Alive”, in the second of which the drawings were animated using the Animated Drawings platform. Activities with programmable devices – Bee-Bot in kindergarten, and Ozobot in primary school, developing skills for spatial orientation and algorithmic thinking.

Criterion S3: School Readiness

School readiness was not developed through isolated activities, but is regarded as an integrative result of all activities realised under Criteria S1 and S2. The thematic framework with the heroine Moniti ensures semantic and emotional coherence between the pedagogical situations, supporting the motivation of the children and creating conditions for more lasting acquisition of knowledge and skills.

Control Stage

The control stage was conducted in the period April – September 2025 with the aim of establishing the results of applying the “MONITI” model and verifying its effectiveness. Final diagnostics were conducted, analogous in structure to the baseline – three tests with 8 tasks each, with a maximum total score of 72 points

The descriptive statistics of the final test results are presented in Table 15. The data show a substantial difference in mean values – 62.6 points for the EG and 51.0 points for the CG, representing an improvement of 14.5 points in the EG compared to only 2.7 points in the CG. Children from both groups were categorised by achievement levels. Most indicative is the change at the low level – not a single child from the EG remains at the low level, while in the CG 5 children (7.1%) still remain at this level. The number of children from the EG at the high level increased from 40 (37.0%) to 87 (80.6%).

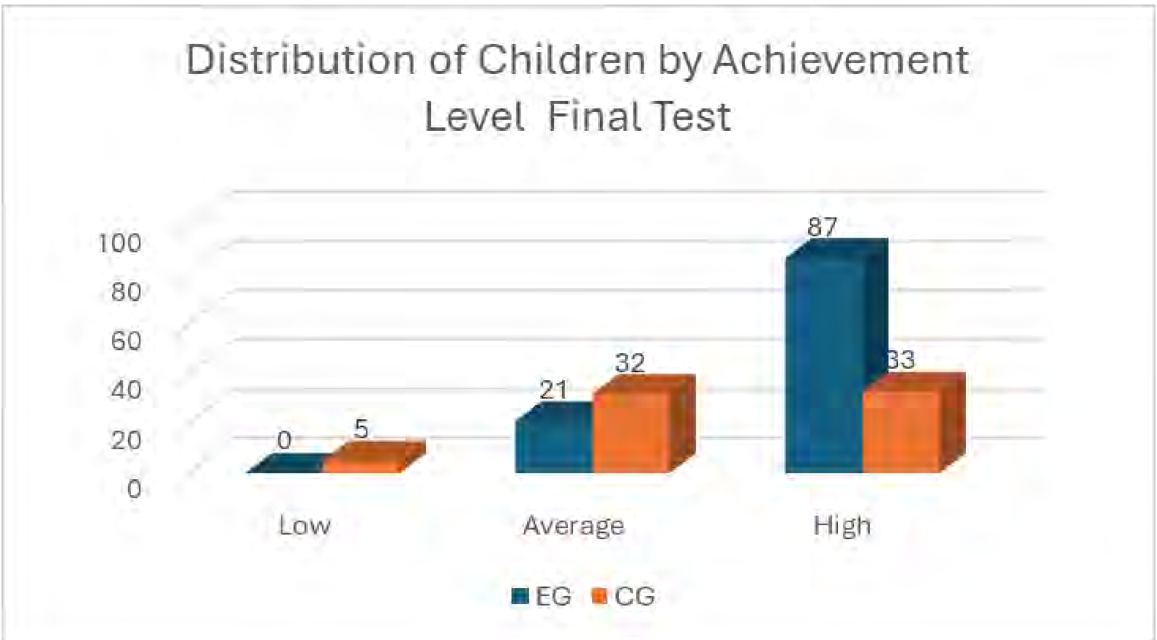

Diagram 7. Distribution of Children by Achievement Level – Final Test

Table 15. Descriptive statistics of final test results in EG and CG

	Group	Final Test
Number of participants (N)	EG	108
	CG	70
Mean	EG	62.6
	CG	51.0
Median	EG	65.0
	CG	54.0
Standard deviation	EG	8.40
	CG	8.83
Minimum	EG	42
	CG	32
Maximum	EG	72
	CG	64

Table 16. Distribution of children by achievement levels on the final test

Level	EG (n=108)	%	CG (n=70)	%
Low (0–36 pts.)	0	0%	5	7.1%
Average (37–54 pts.)	21	19.4%	32	45.7%
High (55–72 pts.)	87	80.6%	33	47.2%

Table 17. Comparative table of baseline and final test results in EG and CG

	EG Baseline	EG Final	EG Difference	CG Baseline	CG Final	CG Difference
Mean	48.1	62.6	+14.5	48.3	51.0	+2.7
Median	50.5	65.0	+14.5	50.5	54.0	+3.5
Std. deviation	9.45	8.40	-1.05	9.10	8.83	-0.27
Minimum	28	42	+14	29	32	+3
Maximum	64	72	+8	60	64	+4

Table 18. Results from the independent-samples t-test comparing EG and CG on the final test

Independent-samples t-test		t-value	df (Degrees of Freedom)	p (Significance Level)	Mean Difference	Standard Error of Mean Difference	95% Confidence Interval			Effect Size
							Lower Bound	Upper Bound		
Final Test	Student's t	8.82	176	< .001	11.6	1.32	9.01	14.2	Cohen's d	1.35

To establish statistically significant differences between the two groups, an independent-samples t-test was applied. The analysis established $t(176) = 8.82$, $p < 0.001$, Cohen's $d = 1.35$, indicating a strong effect of the applied pedagogical intervention. The confidence interval (95% CI = 9.01 – 14.2) does not include zero, which additionally confirms the statistically significant difference in favour of the EG. The null hypothesis (H_0) is rejected and the alternative hypothesis (H_1) is accepted.

For a more in-depth examination of the relationship between the baseline and final levels, a correlation analysis by level was conducted. For children at the low level, the correlation in the EG is $r = -0.09$, meaning a practical absence of linear relationship – the model has “broken” the dependence between the baseline and final level for the weakest children. In the CG, the same correlation is $r = 0.33$, showing that without structured pedagogical intervention, the baseline level continues to determine the final level. At the average level, the correlations are $r = 0.80$ for the EG and $r = 0.91$ for the CG, and at the high level – $r = 0.49$ for the EG and $r = 0.72$ for the CG.

The linear regression analysis, in which the baseline test was used as the predictor and the final test as the dependent variable, shows that in the CG the baseline level explains 92.4% of the variance in the final test ($R^2 = 0.924$), while in the EG this value is significantly lower –

R^2 = 0.728. The difference of 19.6 percentage points represents precisely that part of the development of children from the EG attributable to the applied pedagogical intervention.

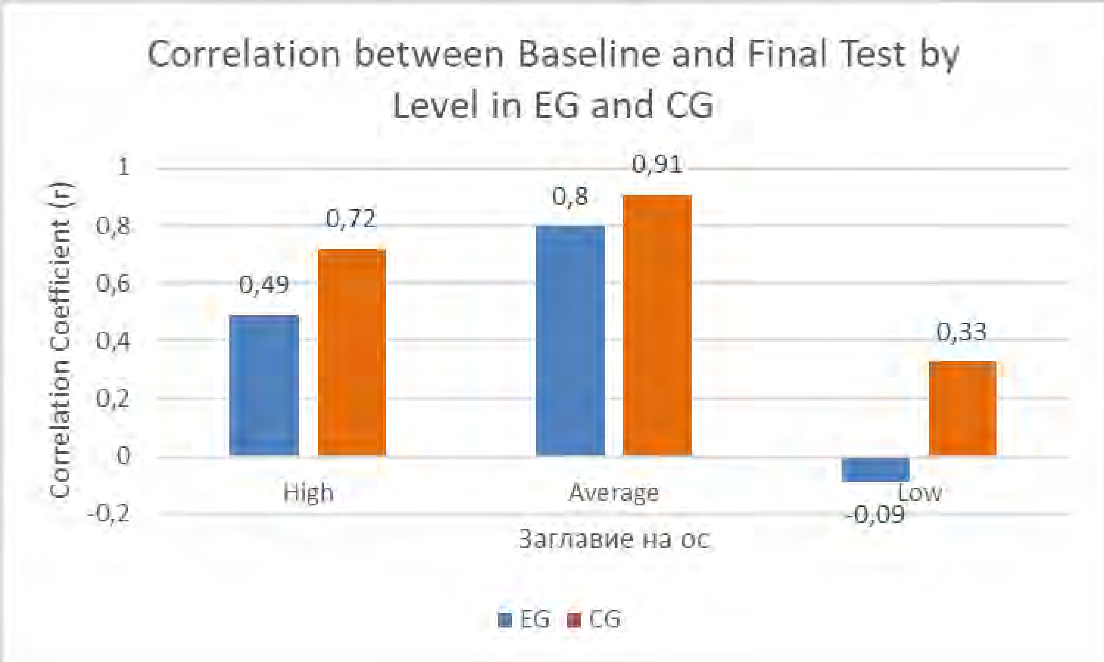

Diagram 8. Correlation between Baseline and Final Test by Level in EG and CG

Table 19. Regression Analysis – Baseline Test as a Predictor of the Final Test in EG and CG

Indicator	EG (n=108)	CG (n=70)
R	0,853	0,961
R^2	0,728	0,924
B (Baseline Test)	0,758	0,933
SE	0,045	0,0325
t	16,9	28,72
p	< .001	< .001

The qualitative analysis based on expert assessment of educational specialists shows a clear positive dynamic in children from the EG, namely higher motivation, greater confidence, better cooperation, and more assured application of knowledge in practical situations. The interview conducted with the children revealed that they associate the activities with a sense of play and enjoyment.

Conclusions from Chapter Three

The conducted study outlines a clear picture of the existing contradiction between pedagogical attitudes and actual educational practice, while simultaneously demonstrating the possibility of overcoming it through targeted and methodologically grounded pedagogical intervention.

The survey established that educational specialists possess a pronounced positive attitude towards play-based approaches and recognise their role in developing functional literacy, but encounter objective limitations in their practice – insufficient resource support, lack of methodological guidance, and a deficit of time. Alongside this, structural imbalances in the educational system were identified: insufficient continuity between preschool and primary education, a discrepancy in expectations of children upon entering first grade, and weak institutional cooperation between the two educational stages. These findings not only justified the need to develop a pedagogical model, but also determined its conceptual orientation and practical content.

The results of the diagnostic work with children confirmed the effectiveness of the developed “MONITI” model with a high degree of statistical significance ($p < .001$) and a strong effect size (Cohen's $d = 1.35$). With an identical initial level in both groups, the children from the EG achieved statistically significantly higher results on the final test compared to the CG, providing grounds for concluding that the established differences are attributable to the applied pedagogical intervention and not to random factors.

The qualitative analysis based on pedagogical observation and expert assessment complements and deepens the quantitative data: children included in the model demonstrate not only higher achievements on the studied indicators, but also more pronounced cognitive motivation, more developed cooperation skills, and a higher degree of independence – characteristics directly linked to the concept of functional literacy and to the formation of sustainable school readiness.

The correlation analysis by achievement level reveals an additional and deeper dimension of the effectiveness of the “MONITI” model, allowing for examination of the extent to which the children's baseline level predetermines the final level in the different subgroups and whether the pedagogical intervention has changed this dependence.

For children at the average level, a strong positive correlation was established in both groups (EG: $r = 0.80$; CG: $r = 0.91$), showing that for this subgroup the baseline level significantly predetermines the final level regardless of the type of pedagogical intervention. Nevertheless, the slightly lower value in the EG indicates that for some children at the average level, the model created conditions for greater progress than expected.

For children at the high level, the correlation in the EG is moderate ($r = 0.49$), while in the CG it is significantly higher ($r = 0.72$). In the control group, children with a good baseline level maintain a predictable developmental trajectory. In the EG, the lower correlation reflects the fact that a significant proportion of children who already had good baseline results achieved even higher results on the final test, exceeding expectations based on their initial level. This indicates that the “MONITI” model stimulated development even in children who started from a better initial position.

The most significant and pedagogically indicative results are observed in children at the low level. In the EG, the correlation is $r = -0.09$, meaning a practical absence of any linear relationship between the baseline and final level. This is an exceptionally important finding – in a traditional pedagogical environment, children with low initial results typically maintain their relative position in the distribution on the final test as well, since the baseline level largely determines further development. In the EG, however, this regularity has been completely overcome: children with a low initial level achieved results that cannot be predicted from their starting level, which is compelling evidence of a qualitative and substantive change in their development. In the CG, the correlation at the same level is $r = 0.33$, showing that without structured pedagogical intervention, the baseline level continues to influence the final level, albeit to a lesser degree.

In its entirety, the correlation analysis confirms that the "MONITI" model has exerted a differentiated and transformative effect on all achievement levels, with the most strongly expressed effect observed precisely in children with the lowest initial indicators. These results complement and enrich the conclusions from the t-test and affirm not only the quantitative but also the qualitative effectiveness of the applied pedagogical intervention.

The regression analysis further confirms and deepens the established results, revealing the extent to which the children's baseline level predetermines the final level in the two groups. In the control group, the baseline test explains 92.4% of the variance in the final test ($R^2 = 0.924$), meaning that without structured pedagogical intervention, the development of children follows an almost entirely predictable trajectory determined by their initial level. In the EG, this predictability is significantly lower – $R^2 = 0.728$, meaning that 27.2% of children's progress cannot be explained by their initial level. This difference of 19.6 percentage points between the two groups represents precisely that part of the development attributable to the applied pedagogical intervention through the "MONITI" model. In its entirety, the results of the regression analysis affirm the model not only as a tool for raising average results, but as a means of qualitative change in the trajectory of children's development, especially for those with lower initial indicators.

CONCLUSION

In its entirety, the present dissertation study provides a scientifically grounded and empirically proven answer to the posed research questions. It demonstrates that functional literacy does not develop in isolation, but as a result of active, meaningful, and play-motivated mathematical activity realised in an integrated educational environment. The research hypothesis is fully confirmed: the application of the "MONITI" pedagogical model leads to a statistically significant increase in functional literacy, mathematical competence, and school readiness of preschool-age children. The null hypothesis is rejected, and the alternative hypothesis is accepted with a high degree of confidence.

Beyond its direct research value, the dissertation formulates questions of broader scientific and practical significance – regarding the need for systematic coordination between educational levels, the development of uniform criteria for school readiness, the targeted methodological and resource support of educational specialists, and the broader integration of digital and programmable technologies in early education. These questions outline the perspectives for future research and practical development, including expansion of the empirical base, long-term follow-up of results, and the development of an accessible digital platform that would make the model widely applicable in various institutional contexts.

The developed “MONITI” pedagogical model and the accompanying methodological toolkit represent a practical contribution to the educational system, offering a realistic, methodologically grounded, and accessible solution to one of the key challenges facing modern preschool education – ensuring conditions in which every child develops the skills, dispositions, and competences necessary for a successful and fulfilling beginning of their educational journey and successful engagement with real-life situations.

PERSPECTIVES FOR FUTURE DEVELOPMENT

1. The developed “MONITI” pedagogical model can be enriched through the inclusion of additional thematic areas adapted to various educational directions in preschool education and different school subjects in primary education. This would enable broader integration of the model in educational practice and would expand its scope beyond mathematical cognitive activity, transforming it into a universal tool for developing functional literacy in early childhood.
2. It is envisaged that the model will be enhanced by expanding the set of play-based and problem-exploration situations, including through wider use of programmable devices, digital resources, and interactive technologies adapted to the age-specific characteristics of children. The integration of modern technological tools would increase children's engagement and contribute to the development of their digital competence as early as preschool age, in accordance with the demands of modern society.
3. The e-book accompanying the MONITI model is to be enriched with additional games, interactive tasks, and educational materials. It is envisaged that it will be expanded with new play situations and didactic materials responding to the needs of preschool-age children and first-grade students. In this way, the enriched e-book will be fully and independently usable by educational specialists in kindergarten and primary school, providing them with ready-to-use materials that can be integrated directly into daily pedagogical practice.
4. Development of a system of qualification courses for educational specialists, aimed at the practical application of the model in daily pedagogical practice. These modules would provide the necessary methodological support and would facilitate the introduction of the MONITI model in various educational institutions across the country, while simultaneously contributing to raising the professional competence of teachers in the field of functional literacy and digital educational technologies.
5. In perspective, it is envisaged to develop an expanded methodological handbook and a digital platform, including scenarios for educational situations, games, diagnostic tools,

and examples of good pedagogical practices. Such a platform would create a sustainable and accessible environment for sharing pedagogical experience and would significantly facilitate the application of the model in various educational institutions throughout the country, regardless of their resource availability.

6. The study can be continued through the expansion of the experimental sample, including a larger number of educational institutions from different regions of Bulgaria, as well as through longer-term follow-up of children's development after their entry into first grade. This would allow for a more in-depth analysis of the sustainability of the achieved results and the long-term impact of the model on children's school adaptation, their motivation for learning, and their overall academic development in the initial stage of education.
7. A perspective for enhancement of the study is the in-depth investigation of the relationship between the development of functional literacy in preschool age and academic achievements in later educational stages. Such a study would contribute significantly to expanding scientific conclusions in this field and to justifying the need for targeted and systematic pedagogical intervention from preschool age onwards, which would lay lasting foundations for the successful educational development of the individual.

MAIN CONTRIBUTIONS OF THE DISSERTATION

Scientific Contribution

An in-depth theoretical analysis of scientific literature related to functional literacy, school readiness, mathematical cognitive activity, and play in preschool age has been carried out. On this basis, the understanding of functional literacy as an integrative characteristic of the child's personality, formed through practical and play-based educational activities, has been systematised and expanded. The theoretical overview outlines the interrelations between mathematical cognitive activity, play, and school preparation in the context of modern education.

Based on the theoretical conclusions, an original “MONITI” model (Mathematics, Environment/Society, Nature, Information Technologies, Play) has been developed, designed for the development of functional literacy and enhancement of school readiness of preschool-age children. The model represents an integrative framework that unites mathematical cognitive activity, play-based approaches, and digital resources in a unified educational concept, adapted to the age-specific and individual characteristics of children and to the normative requirements of the current educational system in Bulgaria.

The analysis of the empirical data collected from the experimental study confirms the research hypothesis that mathematical cognitive activity and play-based approaches, realised through the MONITI model, represent a reliable and effective means of developing functional literacy and enhancing school readiness of preschool-age children.

Scientific-Applied Contribution

Extensive and targeted experimental work was carried out, encompassing four successive stages: preparatory, ascertaining, formative, and control. Within the framework of these stages, the effectiveness of the MONITI model was tested in a real educational environment, and the results from the ascertaining and control stages were compared and analysed with a view to the changes that occurred in the development of children's functional literacy and school readiness.

In the educational situations, thematic scenarios with a permanent character named Moniti, created through artificial intelligence tools, were integrated. The character simultaneously fulfils a motivational, emotional, and cognitive function, ensuring thematic coherence between the individual educational situations and maintaining the children's sustained interest in the educational content. The use of an AI-generated character as a pedagogical tool represents an innovative methodological approach that contributes to deeper emotional engagement of children and more effective application of mathematical knowledge in problem-exploration and life contexts. This approach reflects contemporary trends in education related to the digitalisation and personalisation of the educational process.

Applied Contribution

The developed MONITI model and the accompanying e-book represent ready-to-use pedagogical tools with direct practical applicability. The model provides educational specialists with a structured methodological framework for planning and conducting educational situations. The development of functional literacy is embedded entirely in the activities carried out during the formative stage, through specially developed educational resources, games, and problem-exploration situations. The e-book complements the model with specific games that can be used directly in educational practice or adapted according to the specific needs of the group and the individual characteristics of the children and young learners. The developed materials are consistent with the normative requirements of the current educational system in Bulgaria, which facilitates their integration into existing practice without the need for significant organisational changes.

LIST OF PUBLICATIONS ON THE DISSERTATION TOPIC

1. Yaneva, D. “Characteristics of Play in Preschool and Primary School Age and Its Role in the Development of Functional Literacy”, 2022, published in: “Education and Technologies”, vol. 13, no. 2, pp. 240–243, ISSN 1314-1791 (PRINT), ISSN 2535-1214 (ONLINE).
https://www.edutechjournal.org/wp-content/uploads/2022/11/2_2022_240-243.pdf

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ACKNOWLEDGEMENTS

I express my sincere gratitude and appreciation to my supervisor, Assoc. Prof. Dr. Krasimira Dimitrova, for her support, patience, and assistance throughout the development of this dissertation. Her recommendations, critical remarks, and guidance were of essential importance for clarifying the conceptual framework and refining the methodology of the study. I particularly value the trust and encouragement towards independent scientific thinking, which contributed not only to the successful completion of the dissertation but also to my professional growth.

PARTICIPATION IN RESEARCH PROJECTS

1. Participation in project: BG-175467353-2022-04-0131 "AMS-STEM-COMP – Adaptive Metric System for Assessment of STEM Competencies in General Education in Secondary Schools (Grades 1–12)".
2. Participation in project: № NIH-467/2022 "Research and Development of Non-standard Qualities of Educational Subjects".
3. Participation in project: BG05M2OP001-2.016-0018-C01 "MODERN-A: MODERNisation in Partnership through Digitalisation of the Academic Ecosystem", funded by the Operational Programme "Science and Education for Smart Growth", co-financed by the European Union through the European Structural and Investment Funds.
4. Participation in project: № NIH-504/2024 "Education for Sustainable Development in Kindergarten and Primary School – Pedagogical Models".
5. National Scientific Programme "Development of Scientific Research and Innovations in the Bulgarian Preschool and School Education System" 2025–2030. Institute of Education, Ministry of Education and Science.

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