
CONFERENCE ARTICLE**Pedagogical Model For Forming Spatial Representations In Primary School Students: Theoretical-Methodological, Content-Activity, And Reflective-Evaluative Foundations****Mamasaidova M.A.**Fergana State University, Associate Professor of the Department of Primary Education Methodology, Doctor of Philosophy (PhD) in Pedagogical Sciences, Fergana, Uzbekistan

ABSTRACT

This paper presents a holistic pedagogical model for forming spatial representations in primary school students, comprising three interconnected blocks: theoretical-methodological, content-practical, and reflective-evaluative. The didactic principles (connection with life, learning through play, a polysensory approach, accounting for individual and age-related characteristics, and activity and independence) and methodological approaches (integrative, activity-based, learner-centered, developmental, synergetic, and constructivist) underlying the model are outlined. The structure of the content block (cognitive-theoretical, geometric, and practical components) and the practice-activity block (teaching methods and tools, including ICT and multimedia, 3D models, and virtual construction sets) is presented. The criteria and levels of the reflective-evaluative block are described (motivational, cognitive, and creative criteria; high, medium, and low levels), along with the feedback mechanism linking the model's blocks. It is concluded that a genuine pedagogical effect is achieved only through the systemic integration of all components of the model.

KEYWORDS

Spatial representations, pedagogical model, didactic principles, methodological approaches, content block, practice-activity block, reflective-evaluative block, primary education, constructivist approach, ICT.

INTRODUCTION

The formation of spatial representations in primary school students is among the most significant, yet still insufficiently systematized, areas of contemporary primary education pedagogy. A spatial representation cannot be reduced to a narrow ability to recognize geometric figures or produce a drawing: it encompasses an entire complex of cognitive processes related to a child's perception of space, shape, volume, direction, distance, and the relative position of objects, followed by the reproduction of these images in the mind, their practical verification through action, and their independent application in new, previously unencountered situations. It is precisely this multi-component and multifunctional nature of the phenomenon that necessitates its purposeful, systematic — rather than episodic — formation.

The relevance of this problem is heightened by the age-related psychological characteristics of younger schoolchildren, who are marked by a predominance of visual-imaginative thinking, a strong need for object-based practical activity and play, and heightened receptiveness to sensory-concrete forms of cognition. If the development of spatial representations does not rest on a systemic pedagogical model but is instead carried out fragmentarily — through isolated exercises or the individual initiative of particular teachers — no stable skill capable of being transferred to new situations is formed. This contradiction, between the objective need for a systemic approach and the fragmentary nature prevailing in practice, defines the problem addressed by the present study.

The purpose of this paper is to present to the international scholarly community a holistic, theoretically grounded, and practically oriented pedagogical model for forming spatial representations in primary school students — encompassing its theoretical-methodological foundations, content-activity

components, and reflective-evaluative mechanism — and to demonstrate the logical interconnection of these three levels of the model as a unified dynamic system.

Materials And Methods

The study is based on methods of theoretical analysis of the psychological-pedagogical and methodological literature, a systemic approach, pedagogical modeling, and comparative analysis and systematization of the content and activity components of the educational process. The model's structural components — the target, motivational-preparatory, content, practice-activity, and reflective-evaluative blocks — were examined in terms of their internal interdependence. The didactic principles (connection with life and practical orientation, learning through play, a polysensory approach, accounting for individual and age-related characteristics, and the principles of activity and independence) and methodological approaches (integrative, activity-based, learner-centered, developmental, synergetic, and constructivist) were separately systematized, and the functional role of each in forming spatial representations was independently determined. Using comparative analysis, three areas of the content block were then examined — cognitive-theoretical knowledge, geometric knowledge, and practical skills — along with the forms of learning activity (cluster, INSERT, fishbone), methods ("look and do," rotation and reflection of figures, construction from models), and tools (paper and cardboard materials, tangram, mosaic, construction sets, ICT and multimedia) of the practice-activity block. Finally, using pedagogical diagnostic methods, three areas of reflection (cognitive, emotional-reflective, communicative-reflective), three evaluation criteria (motivational, cognitive, creative), and three levels of performance (high, medium, low) were characterized.

1. Theoretical-methodological foundations of the model

The analysis showed that the principle of connection with life links a student's spatial knowledge to everyday objects — items in the classroom, the home, and nature — giving abstract spatial concepts concrete, personally meaningful content. The principle of learning through play is realized through tangrams, puzzles, mosaics, and graphic dictation, which take into account younger schoolchildren's natural interest in play activity. The polysensory approach ensures the harmonious interaction of visual, auditory, motor, tactile, and verbal channels of perception, while the principle of individuality requires adapting tasks to each student's attention span, visual memory, and level of spatial preparedness.

The integrative approach, in turn, connects the formation of spatial representations with mathematics, technology, fine art, and STEAM tasks, ensuring the process's interdisciplinary character. The activity-based approach involves students working directly with real objects, drawings, models, and digital representations. The learner-centered approach requires differentiation of tasks; the developmental approach guides students toward independently comprehending new spatial relationships; the synergetic approach explains the emergence of a holistic pedagogical effect as the result of the interaction of the model's components; and the constructivist approach ensures that students independently "construct" knowledge through their own experience and practical action. Taken together, these principles and approaches form the theoretical-methodological foundation of the model, without which the subsequent content and activity blocks would lose their systemic coherence.

2. Content and practice-activity blocks

The effectiveness of the pedagogical model depends to a significant degree on how consistently and coherently its content and practice-activity blocks are organized. The content block forms spatial concepts in students on a theoretical level, while the practice-activity block consolidates this knowledge through real actions, exercises, and tasks; in the absence of a firm connection between the two, theoretical knowledge remains superficial and practical exercises become unsystematic.

The cognitive-theoretical component of the content block introduces students to the concepts of space, direction, distance, volume, shape, and coordinates through visual examples. The geometric component covers the properties of circles, triangles, squares, cubes, spheres, cylinders, and cones, as well as the concepts of symmetry, rotation, and reflection. The practical component ensures the application of this knowledge in real activity — construction, model-making, creating drawings and diagrams, and working with 3D models.

In the practice-activity block, the student acts not as a passive recipient of information but as an active subject — one who observes, compares, models, and explains their own actions. Cluster and INSERT methods visually reflect the connections between concepts, while the fishbone method helps identify the relationship among "problem — cause — means — result." The "look and do" method includes stages of observing a model, recreating it, and comparing the result with the model. ICT and multimedia tools — in particular, 3D models and interactive tasks — make it possible to view an object from different angles, rotate it, and take it apart into its components, thereby supplementing traditional visual aids rather than fully replacing them. The recommended strategy involves a staged integration: the student first handles a real object, then observes its digital 3D representation, and afterward makes a practical paper model — ensuring a transition from the concrete-sensory to the abstract-logical level of mastering spatial relationships.

3. The reflective-evaluative block

The concluding and, at the same time, governing element of the

pedagogical model is the reflective-evaluative block, which ensures that students consciously reflect on the activity performed, determine the effectiveness of the process, and set subsequent pedagogical objectives. Evaluation in this context is regarded not as a simple recording of the final result, but as a pedagogical mechanism that reveals how the student understood the spatial task, at what stage difficulties arose, and how convincingly the student was able to present their own solution.

Reflection is examined along three dimensions: cognitive reflection helps students become aware of their own thought process through questions such as "How did I recognize the shape?" and "How did I build the model?"; the emotional-reflective dimension expresses the student's interest in the task and confidence in their own abilities; and the communicative-reflective dimension is manifested through verbal explanation of completed work and the exchange of views within a group.

The evaluation criteria are grouped into three areas: the motivational criterion determines a student's interest in and engagement with spatial tasks; the cognitive criterion assesses the degree to which concepts of space, direction, volume, and symmetry have been understood; and the creative criterion assesses the ability to create new forms and propose original solutions. At the high level, students independently grasp spatial relationships and are able to justify their own solutions; at the medium level, basic concepts have been mastered, but partial assistance is required for more complex tasks; at the low level, students experience difficulty distinguishing shape, direction, and distance and require constant support.

The results obtained at the reflective-evaluative stage give teachers the opportunity to refine the objectives of subsequent lessons, enrich the content, adjust task difficulty, and organize individualized assistance. This confirms that the model does not function in a single direction but operates cyclically, based on continuous feedback among goal, content, activity, and evaluation.

4. Practical significance and prospects for applying the model

The presented model has pronounced applied potential and can be adapted both to traditional classroom-based instruction and to blended and digital learning environments — a point of particular relevance given the ongoing digitalization of primary education across different countries. The model's flexibility lies in the possibility of varying specific methods and tools (tangrams, mosaics, construction sets, 3D models, virtual construction sets) depending on an institution's material and technical resources, while preserving the overall logic of moving from the theoretical understanding of spatial concepts to their practical consolidation and subsequent reflective evaluation.

An important aspect of the model is also its interdisciplinary potential: the integrative approach underlying it allows the principles and methods developed to be applied not only in mathematics lessons but also within technology, fine art, and STEAM education, creating conditions for students to form a holistic picture of spatial relationships across various subjects. Moreover, the synergetic and constructivist character of the model implies its openness: individual components (for example, ICT tools or specific diagnostic techniques) can be updated and supplemented as educational technologies evolve, without disrupting the integrity of the model as a system.

The theoretical results obtained provide a foundation for further experimental testing of the model under real educational conditions, as well as for developing quantitative diagnostic tools that can objectively track the dynamics of spatial-representation formation in students at different stages of primary schooling. A comparative study of the model's effectiveness across different national primary education systems also appears promising and could become a subject of further international scholarly cooperation.

Conclusion

The analysis conducted shows that the process of forming spatial representations in primary school students cannot rest on a single principle or approach — it requires the systemic combination of several complementary theoretical-methodological foundations, content-activity components, and a reflective-evaluative mechanism. This integrity ensures the scientific validity of the model and transforms it from a collection of incidental methodological techniques into a coherent, purposeful pedagogical system.

The model's three interconnected blocks — theoretical-methodological, content-practical, and reflective-evaluative — form a unified dynamic system that functions on the basis of continuous feedback among goal, content, activity, and evaluation. The practical significance of the model lies in its adaptability to various educational contexts and academic disciplines while preserving its overall logic: from the theoretical understanding of spatial concepts, through practice-based consolidation using both traditional and digital tools, to reflective awareness and diagnostic evaluation of the outcome. Further research may focus on the empirical testing of the model in various educational systems, as well as on developing diagnostic tools for the quantitative assessment of the level of spatial-representation formation in primary school students.

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