
CONFERENCE ARTICLE**A pedagogical model for developing spatial imagination in primary school pupils:
theoretical-methodological, content-activity and reflective-evaluative foundations
Factors in the development of spatial thinking and representations in primary school-age
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ABSTRACT

This paper presents an integrated pedagogical model for developing spatial imagination in primary school pupils, comprising three interrelated blocks: a theoretical-methodological block, a content-and-activity block, and a reflective-evaluative block. It outlines the didactic principles underlying the model — connection with everyday life, learning through play, a multisensory approach, attention to individual and age-related characteristics, and activity and independence — together with the methodological approaches on which it rests: integrative, activity-based, learner-centred, developmental, synergetic, and constructivist. The content block is shown to comprise theoretical-cognitive, geometric, and practical-skills components, while the activity block draws on clustering, INSERT and fishbone techniques, the "observe-and-do" method, and a range of tools including paper-and-cardboard materials, tangrams, mosaics, construction sets, and ICT/multimedia resources such as 3D models and virtual constructors. The reflective-evaluative block is characterised through three assessment criteria — motivational, cognitive, and creative — and three performance levels (high, average, low), together with the feedback mechanism that links all blocks of the model. It is concluded that a genuine pedagogical effect is achieved only when all three blocks operate as a single, systemically integrated whole.

Keywords: Spatial imagination, pedagogical model, didactic principles, methodological approaches, content block, activity block, reflective-evaluative block, primary education, constructivist approach, ICT, 3D modelling.

INTRODUCTION

The development of spatial imagination in primary school pupils remains one of the most pressing, yet still insufficiently systematised, concerns of contemporary primary-education pedagogy. Spatial imagination cannot be reduced to the narrow ability to recognise geometric shapes or execute a technical drawing; rather, it comprises a complex set of cognitive processes through which a child perceives space, shape, volume, direction, distance, proportion and location, mentally reconstructs these images, tests them through practical action, and independently applies them in new, previously unencountered situations. It is precisely this multidimensional and multifunctional character of the phenomenon that makes its purposeful, systemic — rather than episodic — formation necessary.

The relevance of the problem is reinforced by the age-related psychological characteristics of younger pupils, for whom visual-imagistic thinking, a strong need for object-based practical activity, and play predominate. When the development of spatial imagination is not grounded in a coherent pedagogical model but is instead left to isolated exercises or the individual initiative of particular teachers, the resulting skill fails to become stable or transferable to new situations. It is this tension — between the evident need for a systemic approach and the fragmentary character that prevails in practice — that defines the problem addressed in the present work.

The purpose of these theses is to present to the international scholarly community a coherent, theoretically grounded and

practice-oriented pedagogical model for developing spatial imagination in primary school pupils, encompassing its theoretical-methodological foundations, its content-and-activity components, and its reflective-evaluative mechanism, and to demonstrate the logical interconnection of these three levels as a single dynamic system.

Materials And Methods

The study draws on theoretical analysis of the psychological-pedagogical and methodological literature, a systems approach, and pedagogical modelling, complemented by comparative analysis and the systematisation of the content and activity components of the educational process. The structural components of the model — the target, motivational-preparatory, content, practical-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 multisensory approach, attention to individual and age characteristics, and the principles of activity and independence) and the methodological approaches (integrative, activity-based, learner-centred, developmental, synergetic and constructivist) underlying the model were systematised, and the functional role of each within the formation of spatial imagination was independently identified.

Comparative analysis was then applied to the three strands of the content block — theoretical-cognitive knowledge, geometric knowledge, and practical skills — as well as to the forms of

learning activity (clustering, INSERT, fishbone), the methods ("observe and do", rotation and reflection of shapes, model-based construction) and the tools (paper-and-cardboard materials, tangrams, mosaics, construction sets, ICT and multimedia) that constitute the practical-activity block. Finally, pedagogical diagnostics were used to characterise the three directions of reflection (cognitive, emotional-reflective, communicative-reflective), the three evaluation criteria (motivational, cognitive, creative), and the three levels of performance (high, average, low).

Results And Discussion

1. Theoretical and Methodological Foundations of the Model

The analysis showed that the principle of connection with life links a pupil's spatial knowledge to everyday objects, the classroom, the home, and natural phenomena, giving concrete, personally meaningful content to otherwise abstract spatial concepts. The principle of learning through play is realised through tangrams, puzzles, mosaics, and graphic dictation, tasks that take into account the natural interest of younger pupils in play-based activity. A multisensory approach harmonises visual, auditory, motor, tactile and verbal-explanatory channels of perception, while the principle of individuality requires that tasks be adapted to each pupil's attention span, visual memory, and level of spatial readiness.

The integrative approach, for its part, links the formation of spatial imagination to mathematics, technology, fine art, and STEAM tasks, ensuring the cross-curricular nature of the process. The activity-based approach presupposes pupils' direct engagement with real objects, drawings, models and digital representations. The learner-centred approach calls for differentiated tasks; the developmental approach guides pupils towards the independent comprehension of new spatial relationships; the synergetic approach explains how a holistic pedagogical effect emerges from the interaction of the model's components; and the constructivist approach ensures that pupils independently "construct" knowledge through their own experience and practical action. Together, these principles and approaches form the theoretical-methodological foundation without which the subsequent content and activity blocks would lose their systemic character.

2. The Content Block and the Practical-Activity Block

The effectiveness of the pedagogical model depends to a considerable extent on how consistently and coherently its content block and practical-activity block are organised. The content block forms pupils' spatial concepts at the theoretical level, whereas the practical-activity block consolidates this knowledge through real actions, exercises and tasks; where the link between the two is not secured, theoretical knowledge remains superficial while practical exercises become an unsystematic accumulation of tasks.

The theoretical-cognitive component of the content block introduces pupils, through illustrative examples, to the concepts of space, direction, distance, volume, shape and coordinate. The geometric component covers the properties of the circle, triangle, square, cube, sphere, cylinder and cone, together with the concepts of symmetry, rotation and reflection. The practical component ensures that this knowledge is applied in genuine activity — construction, model-making, the creation of drawings and diagrams, and work with 3D models.

Within the practical-activity block, the pupil is not a passive recipient of information but an active subject who observes, compares, models and explains. Clustering and INSERT techniques make the connections between concepts visually explicit, while the fishbone technique helps to identify the relationship between problem, cause, means and result. The "observe-and-do" method comprises the stages of observing a model, recreating it, and comparing the outcome with the original. ICT and multimedia tools — in particular 3D models and

interactive tasks — allow an object to be viewed from different angles, rotated, and broken down into its component parts, thereby supplementing traditional visual aids without fully replacing them. The recommended strategy is a staged integration in which the pupil first handles a real object, then observes its digital 3D representation, and finally creates a practical paper model — a sequence that supports the transition from concrete-sensory to abstract-logical mastery of spatial relationships.

3. The Reflective-Evaluative Block

The concluding and, at the same time, regulatory element of the pedagogical model is the reflective-evaluative block, which ensures that pupils consciously make sense of the activity they have carried out, establishes the effectiveness of the process, and determines the direction of subsequent pedagogical influence. Evaluation, in this context, is treated not merely as the recording of a final outcome but as a pedagogical mechanism that reveals how a pupil understood a spatial task, at which stage difficulties arose, and how convincingly the pupil was able to justify a chosen solution.

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

Evaluation criteria are grouped into three areas: the motivational criterion captures pupils' interest in and engagement with spatial tasks; the cognitive criterion measures the degree to which concepts of space, direction, volume and symmetry have been understood; and the creative criterion assesses the ability to generate new forms and propose unconventional solutions. At the high level, a pupil independently grasps spatial relationships and is able to justify a chosen solution; at the average level, basic concepts have been mastered, though partial assistance is still required for more complex tasks; at the low level, a pupil struggles to distinguish shape, direction and distance and requires continuous support.

The results obtained at the reflective-evaluative stage give teachers the means to clarify objectives for subsequent lessons, enrich content, adjust task difficulty, and organise individualised support. This confirms that the model does not operate in a single, linear direction but functions as a dynamic system sustained by continuous feedback among objective, content, activity and evaluation.

Conclusion

The analysis presented here shows that the formation of spatial imagination in primary school pupils cannot rely on a single principle or a single approach: it requires the systemic combination of several complementary theoretical-methodological foundations, content-and-activity components, and a reflective-evaluative mechanism. This integrity ensures the scientific soundness of the model and transforms it from a collection of incidental methodological techniques into a purposeful, coherent pedagogical system.

The model's three interconnected blocks — theoretical-methodological, content-and-practical, and reflective-evaluative — together form a single dynamic system that operates through continuous feedback among objective, content, activity and evaluation. The model's practical significance lies in its adaptability to different educational contexts and subject areas while preserving its overall logic: from the theoretical understanding of spatial concepts, through practical-activity consolidation using both traditional and digital tools, to reflective awareness and diagnostic evaluation of outcomes. Future research might usefully focus on the empirical validation

of the model across different educational systems, as well as on the development of diagnostic instruments for the quantitative assessment of spatial-imagination levels among primary school pupils.

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