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METHODOLOGY FOR FORMING SPATIAL REPRESENTATIONS IN PRIMARY SCHOOL MATHEMATICS TEXTBOOKS

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Abstract: This article explores effective methodologies for forming spatial representations in primary school students through mathematics textbooks. The development of spatial thinking is considered a fundamental component of mathematical competence, especially in early education. The study analyzes the content, structure, and didactic potential of primary school mathematics textbooks, focusing on how geometric materials contribute to the formation of spatial imagination.

Keywords:spatial representations, primary education, mathematics textbooks, geometry teaching, spatial thinking, teaching methodology, primary school students, didactic tools, visual learning, cognitive development

Introduction. The development of spatial reasoning skills in primary school students is considered one of the essential components of modern mathematical education. Spatial representation refers to the ability to perceive, imagine, and mentally manipulate objects and their relationships in space. This ability forms the basis for understanding geometry, measurement, and many real-world problem-solving situations. In early education, students are in a stage where cognitive development is closely linked to visual perception and concrete experiences, which makes spatial learning particularly significant.

Primary school mathematics textbooks play a central role in shaping these abilities, as they provide structured content, visual materials, and tasks that guide students' learning processes.However, despite the inclusion of geometric elements, many textbooks do not fully utilize methodological approaches aimed at systematically developing spatial thinking. This creates a need for revising and improving instructional strategies within textbook design and classroom practice.

The aim of this study is to analyze the methodology used in primary school mathematics textbooks for forming spatial representations and to identify effective pedagogical approaches that enhance students' spatial reasoning skills.

Methods. This study is based on a qualitative research design combining theoretical analysis and pedagogical observation. The content of primary school mathematics textbooks was analyzed using a comparative method to identify how spatial concepts are presented and structured. Special attention was given to geometric topics, visual materials, and the use of positional language.

In addition, classroom observations were conducted to examine how students interact with textbook tasks related to spatial learning. The effectiveness of different teaching approaches, including traditional and interactive methods, was evaluated. The study also employed a system analysis approach to understand the relationship between textbook content, teaching methods, and students' cognitive

development.The research draws upon established educational theories, particularly Piaget's cognitive development theory and Vygotsky's sociocultural approach, to interpret the findings and justify methodological recommendations.

Results. The analysis revealed that spatial representations in primary school mathematics textbooks are developed through several key components. One of the primary elements is the introduction of basic geometric shapes, such as circles, squares, and triangles, which help students recognize and differentiate objects based on their properties. These concepts are typically supported by visual illustrations that enhance understanding.

Another important component is the use of positional language, including terms such as above, below, left, right, in front of, and behind. These terms allow students to understand spatial relationships and orientation. However, the study found that their use is often limited to isolated exercises rather than being integrated into broader learning contexts.

Practical activities, such as cutting, folding, and constructing models, were identified as highly effective in developing spatial understanding. Students who engaged in hands-on tasks demonstrated a better ability to visualize and manipulate objects mentally. Additionally, visual materials, including diagrams and real-life representations, played a significant role in bridging the gap between concrete and abstract thinking.

The study also found that interactive teaching methods significantly improve the formation of spatial representations. Activities such as drawing from imagination, solving spatial puzzles, and using construction tools increased student engagement and enhanced cognitive development. Compared to traditional methods, these approaches resulted in higher levels of spatial reasoning skills among students.

Discussion. The findings of this study confirm that the development of spatial representations requires more than the mere inclusion of geometric content in textbooks. Effective learning occurs when students actively engage with visual and practical tasks that stimulate their cognitive processes. This supports Piaget's view that children learn best through concrete experiences and Vygotsky's emphasis on guided learning.

The results also highlight the importance of integrating spatial learning across different areas of mathematics. Rather than treating geometry as a separate topic, spatial reasoning should be incorporated into various mathematical activities, including measurement, pattern recognition, and problem-solving tasks.

Another key issue is the role of teachers in implementing textbook content. Even well-designed textbooks may not achieve their full potential without appropriate pedagogical strategies. Teachers should be encouraged to use interactive methods, adapt textbook materials, and provide additional activities that promote spatial thinking.

Furthermore, the integration of digital technologies offers new opportunities for enhancing spatial learning. Interactive applications and 3D modeling tools can

complement traditional textbooks and provide dynamic learning experiences. These tools can help students visualize complex concepts and develop a deeper understanding of spatial relationships.

Conclusion. The study concludes that forming spatial representations in primary school mathematics textbooks requires a comprehensive methodological approach that integrates visual, practical, and interactive elements. Textbooks should be designed to support active learning and cognitive engagement, rather than relying solely on passive instruction.

The use of interactive teaching methods, practical activities, and rich visual materials significantly enhances students' spatial reasoning abilities. In addition, the integration of spatial learning across different mathematical topics and the effective use of digital tools contribute to more meaningful and sustainable learning outcomes.

Future research should focus on developing innovative models for teaching spatial concepts and creating assessment tools to measure students' progress in spatial reasoning. Improving textbook design and teacher training will play a crucial role in achieving these goals.

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