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Theoretical and Practical Foundations for the Formation of Concepts about Geometric Shapes in Preschool Education

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A B S T R A C T
The preschool education system serves as a fundamental stage in preparing children for future learning processes. During this period, a child's thinking, aesthetic sense, observation skills, and logical reasoning begin to form. Introducing basic concepts of geometric shapes plays a crucial role in the cognitive development of preschool-aged children. Teaching geometric shapes fosters spatial thinking, understanding relationships between objects, comparing, differentiating, and grouping—essential logical operations that underpin subjects such as mathematics, arts, labor education, and environmental studies. Therefore, developing children's understanding of geometric shapes is considered a vital pedagogical task for enhancing their thinking, imagination, and perception.

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Main part

In light of recent reforms in the education system, there is a growing emphasis on ensuring early childhood development and improving educational processes that consider children's interests and individual characteristics. One of the key priorities is forming elementary mathematical knowledge, especially geometric concepts, through modern pedagogical methods. Although national preschool education programs highlight the need for children to identify, compare, and classify shapes, many educators and parents lack comprehensive methodological approaches to implement this effectively.

With the help of innovative teaching technologies, game-based methods, interactive strategies, and didactic materials, it is possible to present geometric concepts in a clearer, more engaging manner. Investigating, analyzing, and systematizing these opportunities underscores the relevance of the topic.

The aim of this study is to explore the theoretical foundations of introducing geometric shapes in preschool institutions and to develop practical, methodical tools to enhance children's spatial and logical thinking. The research tasks include analyzing theoretical views on shaping geometric concepts in early childhood, evaluating current methodological tools, designing effective teaching strategies tailored to the psychological characteristics of preschoolers, and creating practical resources and recommendations based on experimental results. Understanding geometric shapes is one of the earliest cognitive skills children develop within the domain of mathematics. These skills lay the groundwork for more complex reasoning, including classification, comparison, and measurement. Research shows that even at the preschool level, children demonstrate an intuitive awareness of shapes and space. The theoretical basis for teaching geometry to preschoolers stems from constructivist learning theories, which emphasize hands-on

learning and active engagement. This section addresses why the formation of geometric concepts is crucial in the preschool stage and the theoretical underpinnings that support such development. The theoretical research methodology used in this study includes a qualitative analysis of key literature in the fields of developmental psychology, educational theory, and early childhood pedagogy. Sources include works by Piaget, Vygotsky, Bruner, and recent studies on early geometry instruction. The study identifies stages of cognitive readiness for geometric understanding and evaluates existing preschool programs and curricular frameworks designed to develop spatial awareness and shape recognition.

Literature Review

The formation of initial geometric concepts in preschool education has been extensively discussed in both international and domestic pedagogical literature. Jean Piaget (1952), in his theory of cognitive development, emphasized that children's spatial perception and shape-related reasoning begin to develop during the transition from the sensorimotor stage to the preoperational stage, which coincides with the preschool years. Lev Vygotsky (1978), in his sociocultural theory, argued that children acquire knowledge through social interaction, dialogue, and play—factors crucial to early geometry education. Additionally, the Montessori method also advocates the use of geometric materials that allow children to learn independently through visual and tactile experiences.

In the context of Uzbekistan's national education system, the 2021 state preschool curriculum highlights the importance of developing children's ability to recognize, classify, and name geometric shapes. Local scholars such as M.T. Tukhtasinova (2019) and D.S. Rakhimova (2022) have noted the effectiveness of playful methods, didactic tools, and interactive technologies in preschool instruction. However, most existing studies lack in-depth experimental validation and rely primarily on theoretical propositions. This gap underlines the need for empirical investigations that substantiate the effectiveness of specific methodological approaches to shape recognition and spatial reasoning in early childhood education. Therefore, this study aims to contribute to the literature by bridging theoretical frameworks with practical application in real classroom settings.

Methodology

This study adopted a qualitative research design to explore the effectiveness of instructional methods used in developing geometric concepts among preschool children. The primary objective was to identify practical and pedagogically sound approaches that enhance children's spatial and logical thinking through structured teaching activities. The study was conducted in three preschool institutions in Surkhandarya region, involving a total of 60 children aged 5 to 6 years.

Multiple data collection techniques were employed, including direct observation, semi-structured interviews, pedagogical experimentation, and task-based assessments. The experiment consisted of two stages: in the first phase, existing teaching practices were observed and documented; in the second phase, instructional sessions were conducted using specially designed materials developed by the researcher, including visual aids, interactive tools, and game-based learning components. After each session, children were assessed on their ability to recognize, name, classify, and combine geometric shapes. Feedback was also gathered from educators through structured interviews to understand their perspectives on instructional methodologies. All qualitative data were analyzed using content analysis to identify recurring patterns and assess the pedagogical effectiveness of different strategies. This methodological approach enabled the study to draw meaningful conclusions about the role of visual, kinesthetic, and interactive resources in fostering geometric understanding in preschool education.

Results and Discussion

The experimental analysis conducted in three preschool institutions revealed that incorporating interactive and play-based methods significantly enhances children's ability to recognize, differentiate, and describe geometric shapes. Before the implementation of the researcher-designed instructional approach, only 38% of children correctly identified basic shapes such as circles, squares, and triangles, and most were unable to distinguish between more complex figures like rectangles and ovals. After the intervention, this number increased to 82%, indicating a marked improvement in shape recognition skills.

Children demonstrated stronger spatial reasoning when learning activities involved hands-on manipulation, such as puzzle solving, tangram building, and shape sorting games. These activities not only helped improve logical thinking but also fostered creativity and cooperative behavior. Visual aids like colorful cards and interactive digital tools further enhanced engagement and retention, especially among children with limited verbal skills. Moreover, educators reported increased motivation and attention span among learners when lessons included sensory and game-based elements.The study also highlighted that methodological consistency and the use of developmentally appropriate materials are critical to success. Children responded more positively when instruction was aligned with their cognitive and psychological characteristics, confirming that visual, auditory, and tactile channels must be integrated for effective preschool geometry instruction. These findings reinforce existing theories by Piaget and Vygotsky while offering practical validation for modern pedagogical practices.

The analysis of the literature revealed that the formation of geometric ideas in preschoolers follows a developmental trajectory. Piaget's theory emphasizes the sensorimotor and preoperational stages, during which children explore the world through physical interaction with objects. Vygotsky's socio-cultural theory highlights the importance of language and adult guidance in shaping abstract understanding. Preschoolers initially recognize shapes based on perceptual features—such as size and color—before gradually learning to identify shapes based on defining properties such as sides, corners, and symmetry. The integration of storytelling, play-based learning, and digital tools further enhances the acquisition of geometric knowledge.

The formation of geometric concepts in preschoolers is closely linked to broader cognitive development, particularly in the areas of perception, memory, and categorization. Effective geometry instruction at this level requires exposure to a rich and varied learning environment where children can physically manipulate shapes and engage in meaningful dialogue about their observations. Theoretical findings suggest that instruction should move from concrete to abstract representations, encouraging children to analyze, compare, and group shapes. It is also important to incorporate interdisciplinary approaches—such as linking geometry with art or physical education—to promote deeper understanding and retention.

Conclusion

This study confirmed that the development of geometric concepts in preschool education is most effective when supported by interactive, visual, and play-based methodologies. The integration of developmentally appropriate materials significantly enhances children's spatial and logical thinking abilities, particularly when delivered through engaging and sensory-rich instruction. Findings suggest that educators should prioritize the use of didactic games, visual tools, and interactive technologies to foster early mathematical thinking. Furthermore, methodical alignment with children's psychological traits is essential to ensure sustained engagement and concept retention. Future research could expand on these results by exploring long-term impacts of early geometric training on primary school mathematics achievement and integrating digital tools into a wider curriculum framework.In conclusion, the development of initial geometric ideas in preschool children is a vital component of early education that supports overall intellectual growth. Theoretical models by Piaget, Vygotsky, and others provide a strong foundation for designing effective teaching strategies that are aligned with the cognitive readiness of young learners. Preschool educators must be equipped with developmentally appropriate methods that introduce geometry in playful, engaging, and meaningful ways. Continued research and innovation in early geometry education will ensure that children build a strong foundation for future mathematical success.

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