AMERICAN JURNAL OF ADVANCED SCIENTIFIC RESEARCH
ISSN 2195-1381 Volume- 5 June 2025
http://ijarer.org/index.php/ij/index#

SUPPORTING COGNITIVE DEVELOPMENT THROUGH GEOMETRIC PROBLEMS IN INCLUSIVE PRIMARY EDUCATION

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Abstract. This article analyzes the issue of developing primary school students' mental abilities through geometric problems. It highlights the importance of geometric problems in fostering logical thinking, spatial perception, and creative thinking within the context of inclusive education. The study examines methodologies for organizing geometric problems based on visual, practical, and logical approaches. Additionally, it demonstrates the effectiveness of teaching methods, group work techniques, and interactive lessons tailored to students' individual needs. The article provides methodological recommendations for teachers on developing primary school students' logical thinking through geometric problems. This approach aims to increase students' interest in the learning process and enhance their independent thinking skills.

Keywords: geometry, primary education, inclusive education, logical thinking, spatial perception, game-based method, visual materials, practical exercises.

Today, the principle of creating equal opportunities for all children is gaining significant importance in the education system. From this perspective, inclusive education is one of the most pressing issues not only in terms of ensuring social justice in society but also in creating the necessary conditions for developing each child's personal abilities. Specifically, the process of inclusive education in primary grades should be organized with consideration for the individual needs of students. This necessitates the improvement of teaching methods and the development of strategies aimed at enhancing the cognitive abilities of diverse students. Due to the intrinsic connection between geometry and mathematical-logical thinking, organizing the educational process in primary grades through geometric problems has a substantial impact on children's mental development. Research demonstrates that studying geometric shapes and their properties stimulates the visual-logical development of thinking, fostering students' skills in analysis, comparison,

generalization, and problem-solving. Particularly in the context of inclusive education, it is possible to develop the mathematical competence of students with varying levels of abilities by applying problem-based learning methods grounded in geometry. This article provides a scientific and theoretical analysis of the concept of inclusive education and its significance, the distinctive features of the inclusive education process in primary grades, and the impact of geometric problems on students' mental development. Additionally, it develops effective methods for teaching students with diverse needs through geometric problems and offers recommendations for their application in inclusive education settings.

When organizing inclusive education in primary grades, it is crucial to consider the individual abilities of students. By developing tasks at various levels of complexity, it becomes possible to uncover the potential of each student and apply suitable teaching methods. This approach is implemented through the following three stages:

- Problems that can be solved with visual aids
- Problems based on practical exercises
- Problems requiring logical thinking

Now let's examine each of these stages in detail.

Problems solved with visual aids. In inclusive education settings, some students may struggle to understand problems using traditional mathematical approaches. For these students, explaining concepts through shapes, colors, diagrams, tables, and other visual aids can be more effective. Below are several geometric problems developed for elementary school students based on a visual approach.

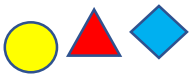
Problem 1: Which shape is extra?

Question: There is a certain pattern in the above sequence. What should the final shape be?

Solution: If a student analyzes the shapes in order, they will notice the following pattern:

 (first group)

 (second group)

 (third group, final form altered)

Thus, the reader should understand that the last shape should have been a

(blue circle) according to the previous pattern.

Outcome: This type of problem develops children's observational skills and their ability to recognize patterns.

Problem 2: Find the identical shape.

Instructions: Carefully examine the image below and identify the one that matches this shape exactly.

Question: What shape is consistently repeated in the above sequence?

Solution: The student needs to observe the pattern and understand that the

(empty square) shape is repeating consistently.

Result: Tasks of this type help develop spatial thinking and logical reasoning.

Problem 3: Draw the final shape.

Instructions: Observe the following shapes, determine how the pattern continues, and draw the last shape in the sequence.

 **?**

Question: What should the final shape be?

Solution: Students should observe the pattern and recognize that the black and white colors are alternating.

Therefore, a (blue triangle) is placed instead of the **?** sign.

Result: This type of problem helps children develop the skill to understand patterns and regularities.

Geometric problems solved using visual aids enhance students' observational skills, develop spatial thinking, foster logical reasoning abilities, and improve their capacity for problem analysis and solution finding. By implementing such problems in inclusive classrooms, it becomes possible to engage students of various levels and provide them with suitable learning methods.

Geometric problems based on practical exercises. In inclusive education settings, it is crucial for students to acquire new knowledge not only through theoretical explanations but also through hands-on activities. Particularly for children with underdeveloped sensory and motor skills or special needs, learning through touching, cutting, arranging, and constructing shapes with their hands proves to be effective. Before assigning tasks to students, it is important to relate them to real-life examples. When problems are based on real-world situations or interesting events, students grasp them more quickly and engage with them enthusiastically. Below are several geometric problems based on such practical exercises.

Problem 1: Let's create geometric shapes.

Required materials: Colored cardboard paper, scissors, glue.

Task: Students are given paper with pre-drawn shapes of a square, triangle, and circle. They need to cut out these shapes using scissors. Then, by combining these shapes, they can create various pictures (for example, a house: square - the body of the house, triangle - the roof, circle - the sun).

Outcome: Students learn to differentiate and combine shapes, develop fine motor skills, and form spatial perception and creative thinking abilities.

Problem 2: Measuring shapes.

Required materials: Tape measure or ruler.

Task: Measure the length and width of various objects in the classroom.

Students should record the results and compare which items are larger or smaller.

Outcome: Students learn to measure and compare in real-life situations, developing logical and analytical thinking skills.

Through practical exercises, students learn to recognize and distinguish geometric shapes, develop spatial reasoning and creative thinking, strengthen fine motor skills and concentration abilities, and understand the connection between mathematics and real life. These methods help meet the needs of each student in inclusive classrooms.

Geometric problems requiring logical thinking. Logical thinking is one of the crucial aspects that develops students' observational skills, ability to analyze, compare, and solve problems. Forming logical reasoning through geometric problems in primary grades is considered one of the effective methods. Such problems allow students to reinforce new knowledge, understand the relationships

between existing concepts, and approach various problems creatively. Below, we will explore geometric problems that require logical thinking and how to present them to students.

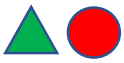
Problem 1: Which shape is out of place?

Objective: To enhance students' observational skills and develop their ability to recognize geometric patterns.

Task: Look at the sequence of shapes below. Identify the one that doesn't belong and explain why it's out of place.

Question: Which shape doesn't fit the pattern?

Solution: If a student analyzes the shapes, they will notice the following pattern:

 (triangle - circle)

 (triangle - rhombus)

 (triangle - circle)

 (lone triangle)

Therefore,  the (rhombus) does not fit the pattern and is considered superfluous.

Practical outcome: Students practice understanding patterns and regularities.

Observational skills and analytical thinking are developed.

Problem 2: What shape is formed?

Objective: To develop students' spatial thinking and visualization abilities.

Task: What shape will be formed if two triangles are joined together?

What shapes will be created if a square is cut along its diagonal?

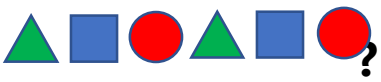
Solution: When two congruent triangles are joined, a quadrilateral (parallelogram or trapezoid) can be formed. If a square is cut along its diagonal, two congruent triangles are produced.

Practical outcome: Students learn to visualize and manipulate shapes. Spatial thinking is developed.

Problem 3: Discover the hidden pattern in shapes

Objective: To develop students' logical thinking and pattern continuation skills.

Task: Examine the following shapes, identify the hidden pattern within them, and continue the sequence.



Question: **?** Which form should be used instead?

Solution: The sequence (triangle - square - circle) is repeating.

Therefore,  a (triangle) shape should be placed instead of the **?** symbol.

Practical result: Students develop the ability to identify and continue patterns. Concentration and analytical thinking skills are enhanced.

Geometric problems that require logical thinking provide students with the following opportunities: It develops logical analysis and decision-making skills, helps to deepen the understanding of geometric shapes, develops the ability to identify patterns and laws, and strengthens a creative approach to problem solving. By using these issues in inclusive classrooms, it is possible to develop the thinking skills of students at different levels and ensure their active involvement in the educational process.

In inclusive education, it is important to organize the educational process taking into account the needs of each student. To develop the mental abilities of primary school students using geometric problems, teachers can use the following methodological recommendations.

Use of a differentiated approach and effective recommendations. A differentiated approach is essential for the successful organization of the educational process in inclusive classes. Since students have different knowledge and skills, choosing tasks adapted to them increases the effectiveness of education. An individual approach, taking into account the level of abilities of each child, is one of the main requirements of inclusive education. For this, it is advisable to use the following recommendations:

- Conduct small diagnostic tests in advance to determine the level of students' abilities.
- Develop problems at three levels (easy, medium, difficult) and create conditions for students to choose a task that suits their abilities.

- Provide complex logical problems and tasks that require additional research for highly capable students.
- Use visual and practical approaches for students who have difficulties with geometry.

A differentiated approach helps create a learning environment that meets the needs of each student and provides individual opportunities to develop their geometric thinking.

Use of game and interactive methods. Teaching geometric problems in a game form increases students' interest and ensures their active participation. Game methods not only serve to consolidate knowledge, but also to develop observation, logical thinking, and spatial thinking. Also, an interactive approach stimulates students' independent thinking and creative approach. To achieve effective results, the following recommendations can be used:

- To increase students' observation skills through the game "Which shape is extra?";
- To develop spatial thinking through the task "Match the shapes with the shadow";
- To develop students' logical thinking skills through team competitions;
- To strengthen spatial imagination and creative thinking through constructive games (making shapes using matchsticks or plasticine).

The use of games and interactive methods not only makes the learning process interesting and effective, but also helps students gain a deeper understanding of geometric concepts.

Use of visual and hands-on materials. Elementary school students learn best through visual and hands-on experiences. Using colorful images, three-dimensional models, and interactive technologies in geometry lessons helps students understand the topic and engage with interest. This approach develops students' spatial imagination and motivates them to deeply understand the topic. The following recommendations can be used for effective teaching:

- Use color images of geometric shapes, cardboard models, and cross-sections in the lesson;
- Explain concepts clearly and concisely using 3D models (cube, pyramid, prism-shaped materials);
- Create opportunities for drawing and manipulating shapes using mathematical interactive whiteboards or smart boards.

The use of visual and practical materials increases students' interest in geometry and helps them better understand the subject.

Encourage group work. Group work allows students to learn from each other and solve problems together. This approach not only reinforces knowledge, but also supports the development of social skills, teamwork, and the exchange of ideas. Through group work, students learn to communicate with each other and gain experience working together to solve complex problems. The following recommendations can be used to organize effective group work:

- Working in small groups – Each group performs different geometric tasks and presents the results;
- Role-playing – Each student performs a specific task (drawing shapes, measuring, comparing, analyzing results);
- Evaluation and exchange of ideas – The results of the group's work are discussed, errors are analyzed, and conclusions are drawn.

The group work method helps students develop skills in collaboration, sharing responsibility, and independent expression.

Peer assessment and reflection. Students' reflection on their own work helps them to strengthen their knowledge and skills. Through the process of reflection, they become aware of their own strengths and weaknesses and identify areas for future self-improvement. Peer assessment, in turn, allows students to develop critical thinking, analytical skills, and an objective approach. The following recommendations can be used for effective reflection and assessment:

- At the end of each lesson, reflect on the topic through questions such as "What did we learn today?" and "What else would you like to know about shapes?"
- Give students the opportunity to evaluate their own work or the work of their friends (for example, develop their thinking process by asking "What shape did you make and why?");
- Reinforce the topic studied and increase student participation through game-like tests.

Thus, reflection and peer assessment develop students' conscious approach to the learning process, increasing their ability to think and analyze independently.

These methodological recommendations can increase the effectiveness of education using geometric problems in inclusive classrooms. A flexible approach to working with students with different levels of abilities in an inclusive environment serves to ensure the inclusivity and quality of education.

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