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METHODS FOR ELIMINATING PROBLEMS AND SHORTCOMINGS IN FORMING THE CONCEPT OF COORDINATES IN PRIMARY SCHOOL

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Abstract

This article analyzes the main problems and shortcomings encountered in the process of forming the concept of coordinates in primary school students and highlights effective ways to overcome them. The study demonstrates the impact of several factors on the educational process, including the insufficient enrichment of textbooks with methodological and practical materials, the lack of teachers’ methodological preparedness, the limited availability of visual-didactic resources, and the individual characteristics of learners. Furthermore, the importance of using interactive teaching methods, a step-by-step instructional approach, real-life examples, and modern technologies in teaching the concept of coordinates is substantiated. The article also reveals the didactic significance of the coordinate system in developing spatial imagination and logical thinking skills among primary school students.

Keywords: Primary education, concept of coordinates, methodology of teaching mathematics, coordinate axis, spatial imagination, didactic tools, methodological problem, interactive methods, problem-based learning, pedagogical approach..

Introduction

In today’s rapidly evolving educational environment, it is essential to ensure that future primary school teachers acquire the necessary competencies to achieve high professional outcomes. The success of any educational system largely depends on the effectiveness of teachers’ instructional practices. From an early

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preschool age, life presents children with countless mathematical challenges. From the moment a child enters school, the institution assumes the function of "life" in an educational sense; it becomes responsible for providing the child with appropriate preparation, fostering mathematical thinking, and teaching them how to identify and solve mathematical problems.

At the primary education stage, particularly in grades 1–4, children encounter many problem situations that stimulate mathematical thinking. For example, if we ask them whether there will be enough learning materials for the whole class, even the simple distribution of notebooks and textbooks can become a challenge for first-grade students.

When children see a relatively small stack of notebooks, they may assume that there will not be enough, as they tend to judge based on the size of objects rather than their quantity. Verifying the accuracy of their assumptions can be done through the actual distribution of the notebooks. This example illustrates a comparison between two sets and the evaluation of the number of elements within those sets[1].

In teaching mathematics, problem-based situations arise quite naturally without requiring any specially designed exercises or artificially created scenarios. In fact, not only every word problem but also nearly half of the other exercises presented in mathematics textbooks and didactic materials inherently contain elements of a problem. Unless their completion is reduced to routine practice based on a ready-made example provided by the teacher, students are expected to think independently about their solutions[2].

Teachers often undermine the effectiveness of learning by focusing on a specific type of problem-solving method with students and then offering a large number of similar exercises in succession. If each of these exercises were instead presented among different types of tasks without additional explanations, they could encourage students to think more independently rather than limiting their reasoning.

Solving complex word problems that require applying previously learned patterns and relationships in new situations, exercises involving the comparison of expressions, and geometry-related tasks that often demand revisiting prior knowledge should be used to present problem-based situations to students. Only in this way can the teaching of mathematics effectively fulfill its educational,

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developmental, and formative functions. It also contributes to the development of students' cognitive abilities and fosters important personal qualities such as determination in achieving goals, initiative, and the ability to overcome difficulties[3].

The coordinate method is one of the main approaches used to solve various planimetric and stereometric problems in geometry lessons. It should be emphasized that the application of this method allows for effective problem-solving not only in mathematics but also in related disciplines such as physics. In particular, the mathematical content of topics in mechanics and kinematics complements concepts such as the "coordinate axis," "point," "coordinate system," and "coordinates of a point." Many problems in these areas are solved based on the coordinate method[4].

The effectiveness of students' mastery of the coordinate method is determined by several factors: preparatory (pedagogical) work aimed at forming basic skills and competencies (such work typically begins in the 5th grade); familiarity with the structure of the method; and the careful selection of a system of tasks designed to develop its individual components. Students should recognize that this method enables them to prove theorems or solve problems in a more rational and elegant way. Moreover, applying the coordinate method in combination with various geometric approaches (that is, as a kind of "hybrid" method) is particularly effective for solving a wide range of geometric problems.

The main objectives of a teacher in teaching the coordinate method are as follows:

-to demonstrate the connection between algebra and geometry;

-to introduce an effective method for solving geometric problems of varying levels of complexity;

-to develop students' computational skills and abilities;

-to enhance students' skills in graphical methods of problem-solving[5].

Using the coordinate method in problem solving typically involves the following steps:

1. Translating the problem into the language of coordinates;
2. Transforming the resulting expression (i.e., the expression formulated in coordinate form);
3. Performing the reverse translation, that is, converting the result back from the language of coordinates into the original terms of the problem.

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Students should be able to see that this method makes it possible to prove theorems or solve problems in a more rational and elegant way. It is also appropriate to use the coordinate method in combination with various geometric approaches (i.e., as a kind of "hybrid" method) for solving a number of geometric problems [4].

Methodological problems arise in every lesson, but they do not usually have a single, fixed solution. In order for a teacher to quickly find the most appropriate solution to a methodological problem in a given learning situation, they must have sufficiently broad professional training in this field. A teacher's methodological competence, awareness of innovations in science and technology, and the ability to apply them in the teaching process and communicate them to students in a timely manner are among the most pressing tasks of today. These factors play an important role in educating the younger generation as mature and well-rounded individuals capable of contributing to the development of the state and society, as well as forming an independent and conscious attitude toward events happening around them, in the country, and in the world[5].

There are several problems and shortcomings in the process of forming the concept of the coordinate system in primary school students, which hinder their full understanding of this topic. Below are the main issues and limitations identified.

1. Insufficient coverage in textbooks

The coordinate system is not always fully and clearly presented in many primary school textbooks. In most cases, these textbooks contain more theoretical material, while the lack of practical exercises, interactive games, and visual didactic tools makes it difficult for students to understand the topic. Therefore, it is necessary to improve textbooks and enrich them with practice-oriented content.

2. Insufficient methodological training of teachers

Some teachers are not sufficiently prepared in the methodology of teaching the coordinate system. This can be a serious problem, especially for those teachers who are unable to apply new teaching methods or integrate modern technologies into the learning process. In order to successfully organize the teaching of the coordinate system, it is necessary to conduct additional methodological seminars and training courses for teachers.

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3. Lack of visual-didactic tools

Visual materials such as coordinate grids, diagrams, and interactive resources play an important role in strengthening the concept of coordinates for primary school students. However, in many schools, such tools are either lacking or outdated. In addition, students differ in their level of visual perception, meaning that the same materials do not affect all learners equally.

4. Individual characteristics of students

Each student has unique characteristics. Some learners easily understand the coordinate system, while for others this process may be significantly more difficult. Differences in age characteristics, prior knowledge, and levels of perception lead to noticeable variations in learning outcomes. Therefore, teachers should apply an individual approach, meaning that lessons must be differentiated according to students' abilities.

5. Limited practical application of the concept of coordinates

Although the coordinate system is widely used in mathematics, engineering, and natural sciences, its practical application in primary school is limited. Students usually work with coordinates only occasionally when solving mathematical problems, while this concept could be more widely applied in subjects such as geometry, geography, or informatics.

6. Lack of student motivation

The coordinate system, as a mathematical concept, may not always be interesting for some students. In particular, if it is taught in a very formal or technical way, learners may lose motivation. To increase students' interest, lessons should be enriched with games, interactive tasks, and real-life examples.

The concept of coordinates is an important topic taught in primary school, and its effective learning helps to develop students' spatial imagination and logical thinking. However, in order to eliminate the problems and shortcomings mentioned above, it is necessary to use new pedagogical approaches and methodologies. At the same time, the wide application of modern technologies and interactive methods helps students to understand and master the coordinate system correctly and more effectively.

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It should be noted that mathematics, along with other subjects, plays a special role in educating the younger generation to become well-rounded individuals. Analytical thinking, logical reasoning, spatial imagination, and abstract thinking are essential abilities for all areas of human activity, and they are formed and developed through the process of learning mathematics. By comparing all subjects that shape human thinking, it can be concluded that mathematics does not study material objects themselves, but rather the properties related to the structure of the objects being examined and the methods of investigation. At present, most mathematical problems, concepts, and theories originate from real-life phenomena and processes. For example, arithmetic and number theory initially emerged from practical problems such as counting objects, while geometry developed from tasks related to comparing distances, measuring the area of plane figures, or determining the volume of spatial objects[5].

At the same time, in ancient times, arithmetic and geometry constituted the whole of mathematics. Mathematics was both theoretical and practical, as both branches had numerous applications in trade, measuring surface areas and volumes, and in ship navigation. In carrying out the tasks mentioned above, it is essential to ensure the effective teaching of school mathematics, especially geometric content, starting from primary school (grades 1–4).

Therefore, in the National Curriculum, topics related to geometry can be presented as a separate section, with concepts arranged in a spiral progression from simple to complex across lessons. The content also includes practical and project-based activities. In the primary school mathematics course, geometric material serves to introduce children to the simplest geometric shapes, develop their spatial imagination, and demonstrate arithmetic laws and relationships. (For example, the representation of a rectangle divided into equal squares can be used to illustrate the commutative property of multiplication.)[5].

From the first grade, concepts such as points, straight and curved lines, segments, rays, polygons and their elements, right angles, and simple spatial shapes are introduced. Students are expected to learn to visualize geometric figures, name them correctly, and draw simple diagrams on grid paper. In addition, it is assumed that they will develop the ability to find the length of broken lines and segments, as well as the area of polygons, rectangles, squares, and other simple shapes (for example, using grid counting methods).

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To overcome the difficulties encountered in teaching the concept of coordinates, it is recommended to implement step-by-step instruction, use real-life examples, and introduce group work methods. If these pedagogical approaches are applied correctly, primary school students can develop solid knowledge and skills in working with the coordinate system.

In conclusion, the problems that arise in the process of forming the concept of coordinates in primary school are mainly related to the abstract nature of the concept, the insufficient development of students' spatial imagination, and the uniformity of teaching methods. To eliminate these shortcomings, it is necessary to use a comprehensive combination of visual, interactive, practical, and real-life situation-based teaching methods. Only in this way can the concept of coordinates be formed in students' minds in a solid, correct, and stable manner.

Thus, instilling in students an understanding of the importance of every subject used in daily life, familiarizing them with its content, and demonstrating it through practical examples contributes to the development of their practical (spiritual) competencies. In analytic geometry, simple geometric figures (points, straight lines, planes, second-order curves, and surfaces) are studied using algebraic tools based on the coordinate method. Analytic geometry is widely applied in physics and engineering, as well as in aviation, rocketry, space science, and spaceflight. It forms the theoretical foundation of many modern branches of geometry, including algebraic, differential, discrete, and computational geometry.

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