THE CONTENT, THEORETICAL FOUNDATIONS, AND EDUCATIONAL SIGNIFICANCE OF THE TOPIC OF SETS IN NEW GENERATION TEXTBOOKS

Xurshida Muxtarovna Iminova
Andijan State Pedagogical Institute Department of "Primary Education", Associate Professor PhD

Abstract: *This article analyzes the role of set theory, one of the fundamental concepts of mathematics, in developing logical thinking in primary school students. In new generation textbooks, the concept of sets is simplified and presented through visual examples, serving to develop students' skills in generalization, classification, and modeling. Fundamental elements of mathematics—such as the definition of a set, the number of elements, the empty set, subset, and relations between sets (union, intersection, difference)—are taught using Euler–Venn diagrams, thereby strengthening logical and visual thinking. This approach allows students to develop interdisciplinary integration, as well as analysis and synthesis skills. Moreover, the topic of sets in primary education is significant not only for the mathematical knowledge system but also as a pedagogical tool for comprehensive intellectual development.*

Keywords: *primary education, mathematics, set theory, set, subset, Euler–Venn diagram, logical thinking, generalization, classification, visual learning, interdisciplinary integration.*

INTRODUCTION

In primary education, the systematic and logical formation of mathematical knowledge plays a crucial role in the development of students' thinking. In particular, the inclusion of set theory, one of the fundamental concepts of mathematics, in new generation textbooks allows cognitive processes to be activated, logical thinking to be developed, and generalization skills to be formed at an early stage. The concept of a set is not only a part of mathematics but also a fundamental component of general intellectual culture. Therefore, the attention given to this topic in 3rd–4th grade new generation mathematics textbooks can be considered an expression of modernized educational content and a competence-based approach.

Set theory was established as an independent branch of mathematics by Georg Cantor at the end of the 19th and beginning of the 20th centuries, based on the intuitive notion of "a collection of objects sharing a common property." In primary school, this concept is simplified and presented visually, while its formal definition and properties are gradually introduced through textbook examples. According to the mathematical definition, a set is a collection of objects of any nature, referred to as elements of the set. The ability to distinguish relationships, commonalities, and differences between objects begins with mastering the concept of a set.

In new generation textbooks, the main properties of sets, such as the definability of a set, the number of elements, and the concept of the empty set, are taught through practical examples. Each set is defined by its elements, and the membership or non-membership of an element in a set is expressed using the symbols "$\in$" and "$\notin$," presented in a simplified form suitable for primary school students. Visual representations, objects, colors, and

shape-based examples allow children to grasp abstract theoretical concepts easily. This approach represents an adaptation of Cantor's fundamental principle—from sets to formal logic—for school education.

Students also become familiar with the concept of a subset while working with sets. A subset is a set whose every element also belongs to another set, symbolized as "⊂" or "⊆." In new generation textbooks, the topic of subsets is taught not only as theoretical knowledge but also through practical tasks that develop classification and generalization skills. For example, the "animals set" and its "subset of birds" or "subset of mammals" link children's intuitive knowledge of biology, ensuring interdisciplinary integration.

Relations between sets are also emphasized in new generation textbooks. Operations such as intersection (A ∩ B), union (A ∪ B), and difference (A \ B) are modeled based on personal experience. Through these concepts, students learn to identify common elements, find specific elements, and evaluate their quantitative and qualitative properties. Such relationships form a core structure of logical thinking: children begin to understand "and" and "or" relations, distinctions between general and specific characteristics, and the membership of an object in multiple categories. This forms a crucial logical foundation for later studies in geometry, informatics, and natural sciences.

Euler–Venn diagrams serve as one of the most modern and scientifically grounded components of new generation textbooks. Through diagrams, children perceive the relationships between sets not only theoretically but also visually. This model allows geometric representation of set intersections, simplifying complex logical relationships and developing comparative analysis skills. Euler–Venn diagrams are widely used not only in mathematics but also in statistics, informatics, and research methodology. Introducing these diagrams in primary education establishes the first steps of modeling, structuring, and visual data analysis skills needed at higher education levels.

Euler–Venn diagrams are a convenient and universal model for representing set relationships. In new generation textbooks, their use reinforces the following knowledge system:

Firstly, the concept of set intersection is introduced. For instance, consider the sets "fruits" and "red objects." The overlapping area in the diagram contains red apples and cherries. This model develops the ability to identify elements present in both sets. The visual depiction of the overlapping area clearly expresses the concept of "commonality."

Secondly, the concept of set union is explained using diagrams. For example, the union of "wild animals" and "domestic animals" sets is represented by the total area covered by two circles, allowing children to observe objects from two different categories together, developing generalization skills. Including elements of both sets visually helps children quickly form logical connections.

Thirdly, the concept of set difference is also easily grasped using diagrams. For instance, for the sets "all geometric shapes" and "circles," the difference set includes squares, triangles, and rectangles. In the diagram, this is represented by the area of one set not overlapping with the other, teaching the cognitive process of isolating a subset from a larger collection.

In new generation textbooks, diagrams are used not only to explain theoretical concepts but also as interactive methods. Students are given tasks to draw diagrams illustrating union, intersection, or difference independently. This activity develops geometric thinking, spatial imagination, logical sequencing, and the ability to distinguish between general and specific characteristics. For example, drawing a diagram for the sets “plants” and “green objects” reinforces interdisciplinary connections, as students learn to interpret biological classification through a mathematical model.

Examples using diagrams also foster analytical and synthetic thinking. For instance, given a Venn diagram for “sports” and “team games,” with the overlapping area including football, basketball, and volleyball, students are asked to add new examples either inside or outside the intersection. This requires independent reasoning and logical justification.

Diagrams in the topic of sets visually clarify abstract formulas that students might otherwise struggle with, teaching the first steps of mathematical modeling. This process later facilitates understanding more complex models such as function graphs, coordinate systems, and diagrams in higher grades. Therefore, diagrams in new generation textbooks serve not only as illustrative tools but also as effective pedagogical methods.

The exercises on sets in new generation textbooks are rich in form and content, requiring not only technical operations but also creative thinking and intellectual activity. For instance, students are asked to identify common properties of objects, determine subsets, construct diagrams, and draw conclusions based on sets. These activities foster analysis, synthesis, comparison, and understanding cause-and-effect relationships, developing systematic thinking and overall intellectual potential.

The topic of sets also holds educational and developmental significance. Classifying objects based on their characteristics teaches children attention, observation, and the ability to substantiate their reasoning. Moreover, since many exercises relate to real-life situations, children learn to analyze their environment systematically. The mathematical concept of sets is functionally linked to classifications, categories, and classes in natural sciences, technology, information technology, and even linguistics.

Conclusion. In summary, the content of the topic of sets in new generation textbooks is scientifically and theoretically well-developed and aims to develop logical thinking, classification, generalization, modeling, and analysis skills in primary school students. Gradual explanation of basic definitions and properties of sets with visual and real-life examples is appropriate for the students’ level, pedagogically sound, and aligned with modern educational requirements. Thus, the topic of sets is not only a component of mathematical knowledge but also an important source for comprehensive intellectual development.

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