

Innovative Approaches to the Mathematics Education of Preschool Children

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Abstract - The scientific article presents some didactic approaches to the formation of mathematical representations in preschool children. The methods and techniques of teaching children mathematics are revealed using developmental and logical games, the need for systematic preparation of children for mastering the school curriculum of mathematics is substantiated.

Keywords - Elementary Mathematical Representations; Didactic Conditions, Methods Of Forming Mathematical Representations; Innovative Technology; Children Of Preschool Age.

Modern educators have great opportunities to construct author programs on mathematical development of a child, which, however, is impossible without a thorough knowledge of the fundamentals and techniques of mathematic theory that is asked by current programs for pre – school educational establishments and primary schools and referring to successful experienced traditional, alternative and various approaches to the mathematical training of children.

Relevant for the enrichment of existing and creation of new techniques and technologies in child's mathematical development modern requirements represent a direction associated with adapting to the specificity of childhood theory of inventive problem solving (TIPS), heuristic training, and mathematical modeling.

These trends contribute to the deepening of teaching formation of mathematical concepts in children; they are

valid sources for scientific correction of program requirements for the content of mathematics given successive both between kindergarten and primary school; they have interesting ideas that facilitate the process of mathematical development of the child in a family environment.

At the present stage of Uzbekistan Republic continuous education system modernization at the pre – school education teachers have the power of constructing some author programs on mathematical development of the child, which, however, is impossible without a thorough knowledge of the fundamentals and techniques of mathematics theory and mathematic methodology, referring to successful experienced traditional, alternative and various approach to the mathematical training of children, defined operating by present programs for preschools and primary schools.

Relevant for the enrichment of existing and creation of new techniques and technologies in the child's mathematical development in a world of modern requirements to the republic pre – school education represents the direction associated with adapting to the specificity of childhood mathematical modeling methods.

Under the process of mathematical modeling with preschool children we understand the teacher organization heuristically oriented process of creating child models through a simple planar and space mathematical abstractions. From this perspective, the mathematical models are divided into categories according to the author's approach of researchers.

Thus, according to Z.A. Mikhailova, technology can be classified according to the action logic, highlighting: mathematic entertainment; puzzle games, tasks, didactic games and exercises.

The techniques, described by B.P. Nikitin, are classified into two types in terms of the intellectual development productivity based on imitation and heuristic laws of cognition models.

Techniques of mathematical modeling with preschoolers can be classified as follows.

1. According to set – theoretic sense:

- Finding of a whole number of given invariant form as a combination of various series of its class division;
- Finding of a whole number of discrete change shape as the combination of constant classes of the partition given by initial form.

2. According to spatial orientation:

- Planar modeling on the basis of cutting the rectangle;
- Spatial modeling based on cutting cuboids;
- On the basis of materials, allowing continuous deformation (having topological features);
- based on the classic origami and flexagons.

In the context of studied subjects the mathematical modeling, on the one hand, is a stage for the development of engineering skills, on the other – is a basis for creative process of the original structure modification at a bit higher logic – schematic level.

According to N.U. Bikbaeva, in the early preschool age (from 1, 5 to 3–4 years) in the development of the child to

the fore role plays the process of own goal activity formation. In the middle preschool age (from 3–4 to 5 years) the main role plays the process of active obtaining activities in various ways.

After 4 years the child's action focuses on the final result. After 4 – 5 years, as it has been observed, there is an enormous interest to various intellects developing information: to letters, numbers, and sensory standards, reading.

At the senior preschool ages (5-7 years) the child is committed not only to imitate adults in their activities, but also to take part in them, properly understanding the ultimate goal.

He learns to assess the obtained result by comparing it with the standard shown in the form of visual images or in the form of a real sample. Preschooler does rather arbitrary control over the activity during the process of intermediate results production; he is interested in real results that can evaluate him, correlating it with the standard.

From this perspective, the process of mathematical modeling allows us to trace the child's logic development of cognitive abilities:

- Mastering the skills of immediate replacement of parts of circuits models of real objects – at a younger age;
- Understanding the actions on the use of ready – made models – in middle age;
- Understanding the actions on models schemes self – construction and construction of new models and schemes – at the senior preschool age.

According to L.A. Wenger, Z.A. Mikhaylova, B.P. Nikitin, N.N. Poddyakova and other scientists' research, the knowledge of the child's logic development of cognitive abilities allows the teacher:

- To see a certain stage of children's development watching their actions in the modeling and constructing;
- To provide a qualitative analysis of children's activities, stimulating to the search for new forms, methods, techniques, materials for further successful mathematical modeling.

Researcher E.L. Porotskaya stresses that preschool childhood is a sensitive period for the cognitive abilities development. According to A.N. Davidchuk, mathematical

modeling is an important part of children's intellectual education, aimed to the development of knowledge.

Sensory abilities are of particular importance for the child's cognitive sphere development, which are manifested in learning objects and their properties. In the context of mathematical modeling with preschoolers it is important to carry out three types of action on sensory standards:

- Identification as establishing the identity of an object perceived quality standard;
- Correlation of an object with the standard, that is not solved simply;
- Perceptual modeling as recreation perceived quality from the standard material.

These first steps are performed in the external plan: children put on, impose objects on each other, running their finger. In the future, they go into the inner plan that occurs "in the mind".

Besides sensory there are **intellectual abilities** in the structure of preschooler's mental development; they are necessary for solving various problems, i.e. associated with thinking. **Visual modeling action** is the basis of these abilities. They are also divided into three types:

- Substitution action (in the early and middle age it is real items, at a senior age it is symbols);
- Use ready – made models (the model is given by an adult and children use it to solve the intellectual problem);
- Children's action on constructing models.

Creative abilities intensively develop in the preschool period and they are associated with imagination, aimed to solving a particular problem. Imagination is productive, it expands reality, objectifies it; children with highly developed imagination have original activity products. In a sphere of mathematical modeling technology the children's creative abilities formation is based on the action of symbolization and modeling, enriching the results of their creativity.

The development of the components of cognitive abilities, sensory, intellectual and creative, goes in two directions: complicating actions on the use of problem solving and changing of given means.

Thus, preschooler's cognitive abilities development process within mathematical modeling can be considered in certain logic (Table. 1).

According to P.Y. Halperin, L.F. Obukhova, T.V. Taruntaeva, D.B. Elkonin and others scientists' researches, the development of mental actions in children occurs successfully in the process of mastering means on the provision of substantial relationships.

Mathematical modeling is one of these means. Learning the ways of using models, children discover the area of mathematical relations on the level of such important concepts as numbers, quantity, shape, order, classification, seriating.

Here are the **types** of problems that can be solved by primary school students on the basis of mathematical modeling skills development at preschool age.

They are made by us on the basis of analysis successive connection of existing educational programs for kindergarten and elementary school and can serve as diagnostic guidelines, to identify the level of preschool children mathematical representations development.

1. Determine, from what the simplest geometric shapes does, shown in the drawing, figure consist; how many rectangles, triangles, circles, squares in its composition.
2. Construct a pattern from geometric shapes.
3. Determine, whether the shapes, shown in the figure, are symmetrical with respect to the given axis.
4. Build a figure that is symmetrical to the given one, relatively symmetrical to the given axis.
5. Determine, how much (how many times) the area of one shape is larger than the other one, by a partition both shapes into equal polygons.
6. Build a sweep of the given compositions of two volume geometric shapes (except cone, cylinder).
7. Determine: whether these shapes are equal, whether they have the axis of symmetry, from which geometric shapes they consist, and if any of them are equal.
8. Fulfill the planar circuit (bulk box) with a predetermined set of geometric shapes in various ways.

Next, the technology of mathematical modeling with kids is described.

Planar modeling on the basis of cutting rectangle

Set – theoretic sense of planar simulation of a whole from parts on the basis of cutting rectangle can be in finding:

- Of a whole, given invariant form (in this case, rectangular) as an association of various series of its class partition – games such as “combine the square”;
- Of a whole of discrete changing shape as the association of constant classes partition the set of the original form (in this case, rectangular) – games like “Tangram”.

Understanding the set – theoretic sense of games of plane orientation allows us to build content of mathematical modeling technology based on their developmental potential.

“Form the square”

The essence of the game

Children must form the square from the several parts of simple geometric shapes and combinations.

Preparation to the game

Invent and produce a sheet of chart that is the key of the game (it must contain at least 10 variants of partitioning the square into 3–5 pieces).

Take the selected number of colored squares no smaller than 8x8 cm; stick them on thick cardboard, put under the press. Mark the squares on invented schemes, number the parts of squares relatively to scheme number, cut, put them into numbered envelopes. You can make a box, into which all squares, stacked one on another fit by height.

Simulation

Early Childhood

1. Give the envelope containing the partition of the original square into 3 parts. Will the child be able to form a colorful path?
2. The number of envelopes gradually increases, squares added, divided into 4 parts, game’s plot can change.

Middle preschool age

1. Give 3–4 parts envelopes. Will the child be able to form colorful flower bed (rectangle)?
2. The number of envelopes is gradually increases; the speed factor is introduced assembly.

3. Offer various plot of the game. For example: “The breeze mixed pieces from several squares (4–5). How to build a path, a flower bed? Who can build number path, the flower bed not by the color, but by the numbers?”

Senior preschool age

1. The tasks are as follows: a child should be able to make out all the squares by color and numbers and put them in order in a time as short as possible (focused on individual interaction of an adult with a child).
2. Propose targets for inventing and manufacturing new variants of cutting the square: in this case it is necessary to add to the set given by children variants of dividing the square that are completely different from the existing ones; observe safety rules when working with children’s scissors*.

As a result, children can learn to analyze images of figures – silhouettes, highlight geometric shapes in them and in surrounding objects. The combinatorial type of problems solution promotes mobility of thinking*.

It should be remembered that the content of activities on mathematical development of the child in any approach must be consistent with its age features and requirements for training, providing further development; consider the possibilities of modern information technologies; provide ways to adjust.

Forms and methods of work are determined by the necessity of realization of humanistic ideas of understanding world through games and a harmonious fusion of social and family education that is provided by self – oriented cooperation of adults with children in the process of organization of children’s activities.

Presented direction define following position to teachers, i.e. suggest the possibility of selecting children’s own ways of solving educational problems and following on it in accordance with its own characteristics, leading to keep unique, multi – level and diversity of preschoolers within mathematics as a field of knowledge.

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