

The Possibilities of Using Methods of Mathematical Modeling Based on Origami in the Development of Preschool Children

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Abstract – In a scientific article, some methodological recommendations are presented for using the technology of mathematical modeling based on Origami in the development and formation of mathematical competencies in children of preschool age.

Keywords – Methods Of Mathematical Modeling, Preschool Children, Mathematical Education, Key Competencies.

Origami (the Japanese “ori” – folded “kami” – paper) is the art of folding paper. The provisions of the significance of the paper modeling for children’s effective and successful mathematical development are not new.

Various technologies using origami are included in the programs of schools and pre – school institutions in many European countries for more than a decade ago.

Simulation on a material origami is the creative process for the teacher. Each time you need to decide what will be the game story of the lesson, how to involve children in them, analyze the mathematical potential of products selected for modeling [1].



Pic. 1. It is useful to stick to the following technological rules.

1. Start the simulation with simple shapes, the kind that are not too abstract. During classes actualize children's knowledge about the world and expand them.
2. Demonstrate the process of folding with a large square with one side white, the other – colored (bright).
3. Always use the correct mathematical terms, connect them with modeling (point, segment, angle, triangle, square, rectangle, diamond, parallel lines, equal segments, angles, shapes, such as triangles, straight, sharp and obtuse angles, bisectors angle; side, the middle part, the middle line, the axis of symmetry sum, diagonal, etc.).
4. On the first classes demonstrate the process of folding circuits without using fairy story (or logical paradox).
5. Gradually accustom children to the conventional signs, schemes (by algorithms).
6. The lesson's logic construction must be as follows: reproductive modeling – self modeling – creative modeling.
7. Give the children homework – ask them to put those shapes, they have learned to do in the kindergarten and ask them to present to their family, friends and loved ones.
8. When children learn to model 5–6 figures, organize a competition “Young origami makers” in two categories: who is faster and whose model is better the other figure.
9. Collect new figures composed by children themselves. Mention their authorship.

Possible types of tasks [2]:

- Fold the figure from memory;
- According to the scheme;
- Verbal management;
- Disassemble the finished figure and sketch the outline of its modeling;
- Create a new figure.

An important feature of origami, which contributed to its rapid spread, is unlimited combinatorial possibilities, opacity in the ordinary sheet of paper.

1. In finding effective means of mathematical modeling with preschool children, it is important to take into account:

2. The provisions of A.V. Beloshistaya, G.Piaget, T.V. Taruntaeva about the specifics of children's intellectual development, the genesis of the child, the amplification of mathematical development;
3. L.S. Vygotsky, L. Zankova's researches about communication and development; S.L. Rubinstein's approval about the quality of the processes of analysis, synthesis and generation as a nucleus of common intellectual abilities;
4. L.A. Wenger, J.A. Ponomariov's directions on the formation of an internal plan of action during 5–7 years children mathematical development.

Modeling by means of origami systematically takes into account these provisions.

Classic origami does not include using sections and bonding for modeling products. However, in the process of working with children a minimum number of products are available for making interesting geometric toys – flexagons – “bendable Polygons”.

Flexagon – one of the simplest mathematical abstractions. It is based on sensory standards form. With proper gathering flexagon contains hidden surface. Here is a scheme for modeling threetetraflexagon – 3 surfaces, one of which is hidden; as the standard form scan the square is used (Figure 1).

As you can see, making a sweep scheme and paint it, as shown in Schemes A and A, is easy enough. Preschooler may need adult's help when bending sweep and combining its ends as shown in the diagrams B, C, D. If you fold obtained square along the vertical midline, it will sweep from other side.

Here is a scheme for modeling gekstageksaflexagon – 6 surfaces, 4 of which are hidden; as a reference form an equilateral triangle is used (Fig. 2). To make a sweep of flexagon and to paint it, as it is shown in Schemes A and A', is not easy, a child cannot do without an adult's help.

Then you have to turn the sweep to your side, as it is shown in Scheme A, and put on the boundaries between the 2nd and the 3rd, 4th and 5th, 6th and 7th, etc. triangles, starting from the left end, so to obtain the shape, shown in Scheme B. This shape should be folded, as shown in Scheme C & D, ensuring that the sides of the resulting hexagon were monochrome; then align and glue the surface marked with an asterisk.

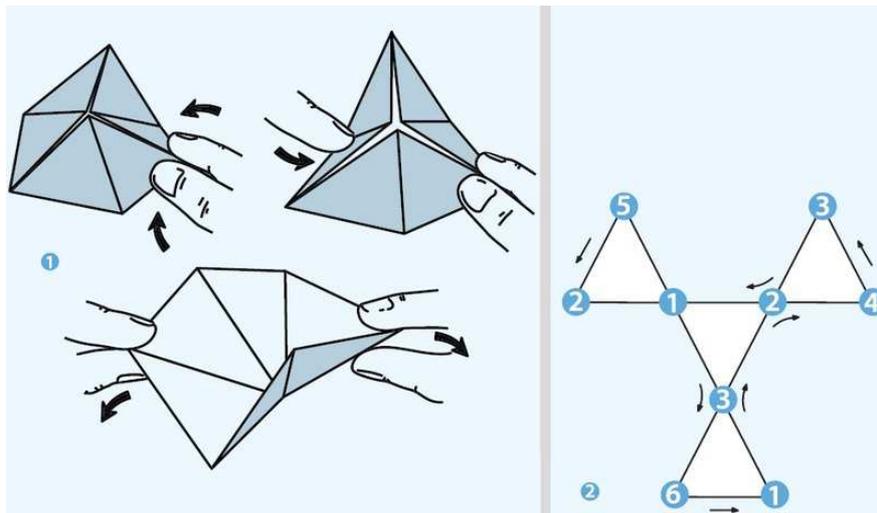


Figure 1. The scheme of three tetraflexagon simulation



Figure 2. Reference form an equilateral triangle

A careful analysis of flexagon scans allows us to reveal them to develop the mathematical potential for preschoolers. From our point of view, flexagon as a means of mathematical modeling has the following special features:

- Economy: for making flexagon we need paper, glue, and scissors and standards forms.
- Availability: with minimal adult help the child not only finds hidden surface of flexagon but also models according to the ready scan, in this process the game and search tasks are dominating, and the assimilation and consolidation of program abilities and skills in elementary mathematics become motivated and active.

- A multi – faceted developing character: flexagons lead to development of fine motor skills, spatial imagination, memory, attention, patience, especially when deliberate coloring activate the formation of imagination in all the branches of mathematics for preschoolers.

To effectively use flexagon as a means of mathematical modeling can be carried out following **series of activities** with children in preschool institutions.

At the initial stage – *the first two sessions* – it is recommended to use colored geksageksafleksagon: children will discover a new “toy”, will examine its properties on the finished models and structure on their scans.

Third session is to devote reproductive simulation of gekstageksafleksagona on the finished scan.

The fourth lesson is children's independent modeling of trigeksafleksagona according to the scheme using ready scans: This flexagon has a simple scan and properties similar to gekstageksafleksagonom, so children successfully manage with its assembly; while scans, proposed to preschoolers, should have a special design – “mathematical stuffing” – to generate ideas for the main sections of the pre – school mathematics.

The fifth lesson introduces the concept of “tritetrageksafleksagon” whose properties are different from those of the previous two. The children make it themselves according to finished scan, they study it in group work with logical – mathematical games such as “Fourth – superfluous” and work individually for hyper active children.

In *the subsequent sessions* there is an active consolidation of the skills of classification and seriating, quantification and number sequence; solving skills and make simple arithmetic problems distinguish and analyze the structure of planar geometric shapes; representations about the seasons, features clock face with three kinds of flexagon [3].

It is important to pay attention to the following aspects of using flexagon in math classroom:

- flexagon serves as a means of learning the ordinal and cardinal account: You can acquaint children with the composition of the number of units, the relations “more – less”, numbers, teach them how to make and solve simple and indirect arithmetic problem (for this purpose, a variety of colors of Flexatone sides are used, taking into account the interests of children of a certain group);

- In the section of geometric shapes it is recommended to acquaint children with triangle, circles, ellipses, squares, rectangles, quadrangles as a class of shapes: flexagon help find the similarities and differences of shapes and make their classification;
- flexagons are good for children to master the concept of “time”: you can use them to show the face of the clock, seasonal phenomena, days, weeks, months;
- Pre – school mathematics topics such as “quantity” and “space” can be studied integrating coloring

flexagon logical – mathematical exercise with the objectives of other private practices [4].

For the organization of the dictionary work, which is required for the development of mathematical literacy, onto all Flexatone surfaces can be applied images of objects on the themes such as: kitchen utensils, furniture, clothing, transportation, trade, toys, family, animals and so on; offer tasks on classification, generalization and simultaneously use flexagons for the development of the sound of speech.

Each type of animal or an object is associated with a particular sound or sound combination, while children can spend phonetic training themselves. Teacher unfolds the Flexatone of necessary part and offers to utter a sound, and to find the same image in their Flexatone. This type of work is also developing general study skills.

Flexagons at the classroom to familiarize with the environment and ecology can be used as a means of preschoolers' cognitive abilities development, ensuring the successful development of elementary mathematical concepts.

The result of this approach is set theory mastering. However, children's nature is more conformed to the opposite approach from set theory and topology in Euclidean geometry. Using options of above mentioned mathematical modeling techniques with children, you can clearly prove this thesis.

Involving children in the modeling and implementation of didactic exercises best implemented through the use of game heroes and individual work with the child – making finger puppets (bibabo). What kind of games to choose from. The teacher decides on a course of learning situation, in accordance with the above logic simulation and features of pupils.

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