Original Article

Use of Mobius Strip Technology In Mathematical Modeling of Children of Senior Preschool Age

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Abstract

The article reveals the features methods of familiarizing preschoolers with the Mobius strip technology. The possibilities of the Mobius strip technology in the development of intellectual and personal qualities, the formation of spatial representations on the plane, visual-figurative thinking, attention, and logic are described. The content of the article focused on developing in modern corresponding modern model of education and training of views on the development of mathematical concepts and abilities of children development of principles of section and design of the content of mathematical education of preschool children. Technology formation process elementary is based on their own views of autonomy and pedagogical creativity. This article is intended for bachelor students, will have essential aid for students of master degree, as well as to candidates of doctors, in matters of improving mathematical education of preschoolers, realization of modern ideas and approaches to the development of preschool children personality.

Keywords: Motivation, Thinking, Skills, Training, Conversation, Symbolic Modeling, Game Exercises, Interactive Game, Solving Mathematical Problems, Didactic Games, Solving Problem Situations, Experimentation, Observation, Collecting Information about the Object Under Study, Reflection.

INTRODUCTION

The main task of developmental work is to provide the child with the opportunity to independently choose the sphere of application of mental efforts, set a goal for himself and find his own ways of achieving it.

The introduced state standards of preschool education have definitely changed the role of the teacher in the education system, and, accordingly, the tasks of the educator. We believe that the teacher should turn from a subject who transfers knowledge into a professional who will teach the child how to acquire knowledge, help develop the child's cognitive interest, the need for learning, and the motivation to learn through innovative technologies.

One of the main principles in the organization of cognitive activity is the stimulation of the child's curiosity. In educational work, various didactic materials should be used that will arouse the interest of the child. One such material is the Möbius strip.

Children love classes in which they are participants in the learning process, then they actively and willingly complete all the tasks offered. It is easy for them to carry out their actions, to draw the simplest conclusions, generalizations.

Research problem: the method of modeling gaming problem-practical situations is a successful way to form learning motivation

The purpose of the study: to develop a methodology for using experimental research activities using the Möbius strip in the educational field "Cognition" with children of senior preschool age.

Hypothesis: In order to be interested in the final result, you need to create a problem situation.

The novelty of the research: this development can be used in work with children of senior preschool age (6-7 years old) as an educational activity of an increased level. It can be recommended for a mathematical circle.

MAIN CONTENT

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.

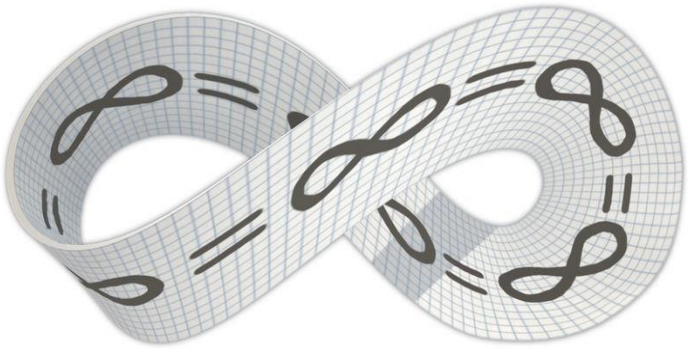
Under the process of mathematical modeling with preschool children we understand the teacher organization heuristically oriented process of creating child models through a simple planar and space mathematical abstractions. From this perspective, the mathematical models are divided into categories according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

In 1861, German mathematician August Ferdinand Mobius suggested the easiest way of creating a one – sided surface. We need to take a narrow strip of paper, twist it on half on one edge, and then glue the edges. We can obtain a geometric figure – a Mobius strip.

Movement along the midline of the shape surface from the fixed point lead to the starting point, that is why Mobius strip is one sided. If you submit a Mobius strip made of rubber, then, no matter how you twist or stretch it, it will remain a one – way, one – sided, single sidedness of Mobius strip is a topological property; it is preserved under homeomorphic transformations.

According to the current program requirements, even senior preschoolers can easily distinguish between simple planar shapes and spatial shapes, they even know what the internal and external surface of the shape is. To simulate Mobius strip under the guidance of the teacher is not very difficult task for children.

In this case, it is important to organize the process of modeling so that children can understand the characteristics of the Mobius strip as a one – sided surface.



SIMULATION

Stage 1. Problem Formulation

Educator. Let's try to answer the question: whether all the items are bilateral?

To understand the essence of the question teacher offers to take an experiment.

Take a box without top cover, lid. In one of the side walls make a pinhole. Imagine that inside the box at the pinhole there is sitting a spider and outside at the same pinhole is an ant.

The ant wants to go on a visit to his friend. Through a pinhole in the wall it cannot crawl, therefore it crawls by passing the creeps. No matter how it crawls, it will have to get over the edge of the box. If the edge will be covered with Velcro, the ant did not reach the goal. Why is that?

Children. Because the bow has two sides.

Educator. Give examples of other bilateral surfaces.

Children. Glass (cylinder), a closed box (cube), brick (parallelepiped), the ball (sphere).

Educator. Before us is a problem – if there is a figure, shape, which has only one surface?

Stage 2. Reproductive Modeling

The children have on their table in front of them the glue, a brush and two similar strips of graph paper, each of which applied to the middle line with felt tip pen. Under the guidance of a teacher from one strip they simulate a "ring" – a cylindrical tape; from another – a Mobius strip, for which strip is twisted near one of the ends of the half – turn, and its ends are stuck together.

Teacher repeatedly utters the name of the new geometrical shape frontally. Then, help children firmly glue the ends of the strips, individually repeating the name of a new shape.

Stage 3. Researching Game

The teacher offers to play with the "ring" and Mobius strip.

Educator. Note any point on the dotted line of cylindrical tape. Imagine that an ant sits here; on the other side there is a spider.

The ant cannot crawl through the hole. How did it get to the spider? Can the ant get to the spider, without going over the edge of the tape?

Children. No.

Educator. Why is that?

Children. This tape has two sides and two ends.

Educator. Now take a Mobius strip and play the same game. At one point an ant is sitting, on the other – the spider. The ant gets to his friend if it crawls over the edge. But if it moves on the dotted line, it also gets to the spider! This is possible because the Mobius strip has magical property – it is one – sided!

Let's play another interesting game – "Write a letter". Imagine that we are going to write a letter in a fairy language.

We cannot take the pencil up from the paper. You cannot cross over the edge. Try, will you be able to fill both sides of the "ring"?

Children. No, because it has two sides.

Educator. And if we write a fairy letter on the Mobius strip? Remember, we cannot take the pencil from the paper, it is impossible to pass over the edge. Whether the Mobius strip is entirely written? Try.

Children. Yes, because it is one – sided.

Stage 4. Heuristic Modeling

Educator. Now let's check your intelligence. Imagine that we cut a cylindrical tape on the dotted line. What is happened?

Children. Two ribbons, narrower ones.

Educator. Yes you are right. And if you cut the Mobius strip, what happens?

Children. Two narrower Mobius strips.

Educator. Let's check.

The teacher cuts the Mobius strip.

What is happened?

Children. One tape tangled 2 times.

Educator. Why is that happened?

Children. Because Mobius strip has one side, it is one – sided.

If the kids are tired, then step 4 will be the last stage. If they show interest in modeling, you can go to step 5.

Stage 5. Practical Researching Modeling Task

1. Make an incision in the midline of that shape, which is obtained by first cutting of a Mobius strip, what happens?
2. Draw and cut out paper soldier; send it to travel along a line, running in the middle of a Mobius strip, in what image will it return to the starting point?
3. And this task for future inventors! Gear belt of a sewing machine is put on the two pulleys. When you rotate one side of the belt touches pulleys surfaces, as for the other – no touching; as a result, the first side wears out and the belt begins to slip.

Suggest a way allowing to us prolong the life of the belt.

In today's kindergarten, then in school children get acquainted with Euclidean geometry, where all valid conversions mainly consist of movements (shifting shapes) mirror reflections (axial symmetry), compression, stretching (similarity).

The top of this approach is the study of the theory of sets, when the shape is allowed to "scatter" on certain points, to form out a new shape from them.

According to Swiss psychologist Jean Piaget, children perceive the geometric properties in reverse order, i.e., it is easier to understand to the baby the difference between small groups of red and blue balls or cubes (set theory), or between a closed and an open in – ring rubber ribbon (topology) than to distinguish rectangular from hexagon (Euclidean geometry). Therefore getting acquainted with a Mobius strip from certain positions completely corresponds to children's nature.

The proposed technology is economical (modeling material is simple and accessible), dynamic (performed in 1– 2 lessons), a new one (provides preschoolers qualitatively development of new class of geometric shapes – one – sided surfaces), based on a wide range of methods and provides frontal variant of realization.

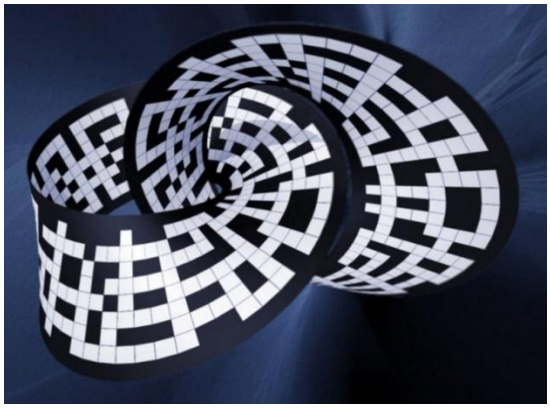
Introduction to the Geometric Shape – Mobius Strip

Objective: To introduce children to a new geometrical shape – Mobius strip and its game technology.

Tasks:

- Consolidate the knowledge of the quadrilateral shape, the ability to prove it's belonging to the class of rectangle shapes;
- Generate ideas about the one – sidedness of the Mobius strip and ability to prove this fact;
- Develop mathematical thinking, the logic of reasoning.

Equipment: strips of paper, any small objects (for example, models of grasshopper and beetle, pencils, pens).



Today, we are going to do some magic with you: from the usual strips of paper we will make an unusual shape – magic shape.

Let us be convinced that strip of paper in front of you is the usual one, the most common.

The teacher shows the children the strip from all sides, twirls it, and twists it.

Who can say what is it like? (*It is long; looks like a rectangle, there are ends*.) Prove that it looks like a rectangle.

Children respond.

How can you imagine what the surface is? Show the surface of the strip. How many surfaces are there in the strip? (*Two*.) How would you have proved that it has two surfaces?

Children offer their answer options.

Set on one surface of the strip the beetle, and on the other – a grasshopper.

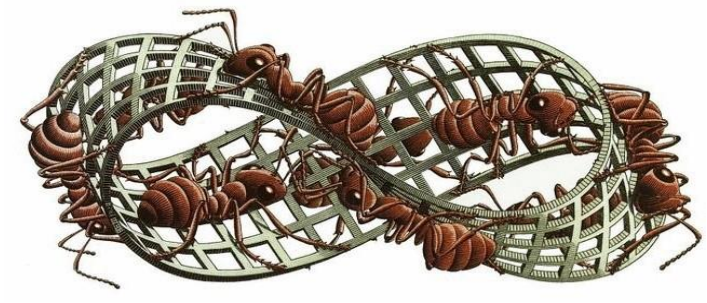
They wanted to meet and see each other. But they are not touching the edges and not looking up from the strip – so as not to fall.

The teacher demonstrates the "way", and then asks 2–3 children to do the same task effectively, then all the children experiment with their models and strips of beetle and grasshopper.

Could the two friends meet each other? (*No.*) It turns out that the stripes have really two sides. This can be proved if you try to "write a letter" on the strip, without lifting the pencil from the paper and without touching the edges.

Children "write letters".

You wrote on one surface of the strip, while the other side remained clean – so how many surfaces are there in the strip? (*Two.*)



And now we turn the strip into an unusual shape. For this I take it at both ends, twist one side on 180 degree and paste non twisted end to twist.

The teacher shows his action, the children repeat after him, the teacher helps to each child.

How would you describe the shape that we get? (*Ring*). Look carefully and tell me what is unusual? (*It is twisted*.) Remember that we have made it from strips with two surfaces. Let's see, how many surfaces do the twisted ring have?

Let's try again "to make friends" from beetle and grasshopper.

Place them on the ring so that the beetle was outside, and a grasshopper – on the inside of the ring, i.e., so that they are located one above the other, and then guide them, keeping hands and not touching the edges of the ring.

The teacher shows his action, the children repeat.

What can we see? It turns out, that the friends meet each other and are on the same surface of the ring. What do you mean, what do you think?

Children respond.

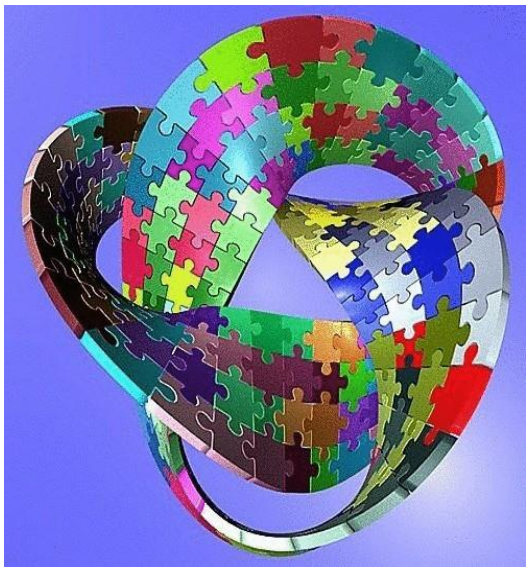
To make sure that the tangled ring has actually one surface, try to draw lines (while the ring do not finish) without lifting the pencil from the paper and without touching the edges of the ring.

The teacher and the children do that task.

See what you have got. Is there an end in our shape? (*No, we came back to the starting point*.) Is there any surface of the ring without your line? (*No*.) What can you say about how many surfaces have tangled rings got? (*One*.)

What do you think, what would happen if we cut the Mobius strip along?

Children offer options.



Check your guesses. What do we see? (*Mobius strip increases, instead of looping to get two*.) Make sure that you are right, maybe I am wrong? What happened to you?

Children cut their Mobius strips, and confirm the correctness of the answer.

Yes, our ring has changed and the number of surfaces, too. How can we check this? It must be done without taking your hands off the paper, without touching the edges of the ring.

Children check whether the number of surfaces of Mobius strip changed after cutting along.

What can you say about the number of sides of the shape? (*The shape has not kept one – sided*.)

What do you think, what can be used as Mobius strip? (*For the decorations on the Christmas tree, show focus.*) To obtain a decoration, first produce a Mobius strip, and then strip for the next ring threaded into the ring ready and only then turn over one end of the strip and glue the ring.

The teacher, explaining his actions show in accompanies all stages.

Now each of you can make a garland or a necklace. Then we put all into one long garland and decorate our group!

It turns out that the Mobius strip – is a very interesting shape. What would you like to tell your friends about that shape?

How would you name differently Mobius strip? How is it different from other rings? Think about the riddle of Mobius strip.

Children answer questions and perform tasks. After making a garland of Mobius strip they decorate puppet area.

Application of the Möbius Strip in Life

There were technical applications of the Möbius strip. The conveyor belt strip was made in the form of a Möbius belt, which allowed it to work longer, because the entire surface of the belt wore out evenly. Also in continuous tape recording systems, Möbius strips were used (to double the recording time).

There is an assumption that the DNA helix itself is also a fragment of the Möbius strip, and this is the only reason why the genetic code is so difficult to decipher and perceive. Moreover - such a structure explains the reason for the onset of biological death - the spiral closes on itself and self-destruction occurs.

Due to its unusual properties, the Möbius strip is widely used by magicians. If you try to cut the ribbon along a line equidistant from the edges, instead of two Möbius strips, you get one long double-sided (twice as twisted as the Möbius strip) ribbon, which magicians call the "Afghan ribbon".

In many dot-matrix printers, the ink ribbon also has the form of a Möbius strip to increase its resource.

Where can you find a Möbius strip?

1. The strip of the belt conveyor is made in the form of a Möbius belt, which allows it to work longer, because the entire surface of the belt wears out evenly.
2. Continuous film recording systems use Möbius strips (to double the recording time).
3. In many matrix printers, the ink ribbon also has the form of a Mobius strip to increase its resource.
4. Tapes for sharpening knives into Mobius strips.
5. International symbol of recycling is a Möbius strip.
6. The Möbius strip in sculpture is presented in various versions: from the traditional to the most incredible.

Conclusion

Reviewed trends help to form logical – diagrammatic thinking on existing relationships and naturally ascribe the child to the world of trivial and nontrivial logic based on creative thinking in children. As a result, preschoolers obtain the ability to understand communication patterns and the things, underlying on the base of scientific knowledge. Naturally, abstract thing remains as figurative thing; however, children are actively seizing conditional algorithmic schemes of thinking – a mental model.

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.

This setting directs teachers to the development of a deep scientific mathematic foundation of theory of sets, the use of unobtrusive methods and techniques that provide the efficiency of formation mathematic representations in all subjects involved in this process.

Analysis of the content of existing programs for pre – school and primary schools in the area of mathematic development, our long – term observations and experimental researches indicate the productivity of synthesis of set – theoretic approach with the study of scalar quantities and their properties.

Effective approaches differ in the following logic: "Set, the quantity – number – the attitude". It is inherent in and discussed also in this guide through modern trends of mathematical development of a child.

References

O'zbekiston Respublikasi Prezidentining "Maktabgacha ta'lim tizimini tubdan takomillashtirish chora-tadbirlari to'g'risida"gi Qarori 3261-PQ, 09.09.2017.// "Xalq so'zi", 11 sentyabr' 2017 yil, 181-son (6845).

Aromshtam M., Baranova O. Spatial geometry for kids. The Adventures of Eraser and Paperclip. Educational classes. – M.: NC ENAS, 2004. – 96c.

Aromshtam O., Baranova O. Spatial geometry for kids. Educational classes. – M.: Enas, 2005. – 94 p.

Arkhipova I.A. Preparing a child for school: Book for parents of a future first-grader. – Yekaterinburg: U – Factoriya, 2004. – 215 p.

Beloshistaya A.V. Formation and development of mathematical abilities of preschoolers. A course of lectures for students of preschool faculties of higher educational institutions. – M.: VLADOS, 2003. – 400s.

Bereslavsky L.Ya. Merry Academy. The first geometric figures. – M.: Makhaon, 2006. – 18 p.

Depman I. Ya., Vilenkin N. Ya. Behind the pages of a mathematics textbook. A book for students of grades 5-6. M.: Enlightenment, 1998.

Mikhailova Z.A., Babaeva T.I. The development of cognitive and research skills in older preschoolers. Methodical manual for teachers. – St. Petersburg: Detstvo – Press, 2012. – 160 p

Perelman Ya.I. Entertaining geometry. M.: Rimis, 2014.

Sharygin I. F., Erganzhieva N.N. Visual geometry. M.: Bustard, 2012.

http://www.sola.narod.ru/top.htm

http://doc4web.ru/matematika/konspekt-uroka-po-matematike-list-mebiusa-klass.html

http://doc4web.ru/matematika/tehnologicheskaya-karta-uroka-po-matematike-topologicheskie-opit.html

http://globuss24.ru/doc/vneklassnoe-meropriyatie-udivitelyniy-list-mebiusa-7-klass

https://urok.1sept.ru/articles/635808

https://urok.1sept.ru/articles/553801/

http://infourok.ru/material.html?mid=16752

http://sc50.jdroo.by/index.php?option=com_content&view=article&id=401%3A-q-q&catid=53%3A2014-03-07-11-57-49&Itemid=118&lang=ru

http://nsportal.ru/shkola/geometriya/library/2012/04/08/tainstvennyy-list-myobiusa

http://www.calculator888.ru/blog/raznoe/lenta-mebiusa.html

http://sbatal.jimdo.com/%D0%BF%D1%80%D0%B8%D0%BC%D0%B5%D0%BD%D0%B5%D0%BD%D0%B8%D0%B5/

http://vestnik-nou1.narod.ru/primenenie_lista_mebiusa_2.htm

http://buckses.info/fizika/

http://stasy-egorova.pldetstva.edusite.ru/p70aa1.html.

Saparov, K., Rasulov, A., & Nizamov, A. (2021). Making geographical names conditions and reasons. World Bulletin of Social Sciences, 4(11), 95-99.

РАСУЛОВ, А.Б., & АБДУЛЛАЕВА, Д.Н. (2020). ПЕДАГОГИЧЕСКИЕ И ПСИХОЛОГИЧЕСКИЕ АСПЕКТЫ РАЗВИТИЯ НАВЫКОВ ИСПОЛЬЗОВАНИЯ САЙТОВ ИНТЕРНЕТАВ ПРОЦЕССЕ повышения квалификацииРАБОТНИКОВ НародНОГО ОБРАЗОВАНИЯ. In Профессионально-личностное развитие будущих специалистов в среде научно-образовательного кластера (pp. 466-470).

Kulmatov, R., Rasulov, A., Kulmatova, D., Rozilhodjaev, B., & Groll, M. (2015). The modern problems of sustainable use and management of irrigated lands on the example of the Bukhara region (Uzbekistan). Journal of Water Resource and Protection, 7(12), 956.

Saparov, K., Rasulov, A., & Nizamov, A. (2021). Problems of regionalization of geographical names. In ИННОВАЦИИ В НАУКЕ, ОБЩЕСТВЕ, ОБРАЗОВАНИИ (pp. 119-121).