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COMBINATORY THINKING SKILL AND HOW TO DEVELOP IT

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Abstract. Logical thinking, creative thinking, analytical thinking - types of thinking known to everyone. However, there are some thought processes that you don't often encounter or hear about. An example of this is the skill of combinatorial thinking, which is what we want to talk about in this article. We will look at the concept itself, give information about the relevance of its development (and you can learn about the development of thinking on a global scale), and also briefly touch on combinatorics, that is, the branch of mathematics that studies combinatorial problems.

Keywords: combinatorics, combinatorial thinking, development of combinatorial thinking skills

INTRODUCTION

In this article, we explore combinatorial thinking, an important aspect of pedagogy that helps students develop logical and analytical thinking, as well as creative problem solving. Combinatorial thinking allows us to consider objects and phenomena in their diversity and interdependence, as well as to find new ways of combining and applying them. In this lecture, we will consider the basic principles of combinatorial thinking, methods of its development, and examples of tasks for teaching. In addition, we will discuss the practical application of combinatorial thinking in various areas of life.

Combinatorial thinking is the ability to see connections and combinations between different elements, it plays an important role in logical thinking, creativity and solving complex problems, and in this article, we will see its meaning, principles and methods of development. we will go out. Also, example problems and practice guides.

LITERATURE ANALYSIS:

The world's leading scientists have been conducting their research since the last century on raising the quality of education in the educational system. These researches are mainly aimed at studying the concept of combinatorial thinking of students and its development in the educational process, and among Russian scientists M.A. Vershinina, L.A. Yevdokimova, M.A. Yekimov, T.G.Popova and others conducted research by In particular, by foreign scholars Batanero, C., Navarro-Pelayo, V., & Godino, J. D. (1997). Effect of the Implicit Combinatorial Model on Combinatorial Reasoning in Secondary School Pupils, "Educational Studies in

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RESEARCH METHODOLOGY:

This in the article combinatorial thinking of skill development content essence, combinatorial thinking skill in development stages, combinatorial thinking levels, combinatorial thinking different to areas application to be done and combinatorial thinking to the concept about given definitions was studied and analysis done. Learned sources and from analyses combinatorial thinking skill in development is available methods whole to form bring, improve according to goal and tasks set received.

ANALYSIS AND RESULTS:

Combinatorial thinking is commonly referred to as a person's ability to solve combinatorial problems. Interestingly, it represents a kind of transition from figurative thinking to abstract-logical thinking and vice versa, because it contains different elements: motivational, operative, substantive, abstract-logical and figurative. By the way, this is one of the reasons why combinatorial thinking is closely related to logic. We also draw your attention to the fact that it is impossible to form this type of thinking independently, and it is necessary to resort to special pedagogical methods for its development.

The essence of combinatorial thinking is that when it is activated, the human brain is busy searching for some elements and transforming them into others, giving

them new forms and combinations. Some features of this process are: Knowledge needed for integration is the content side of the combinatorial process; The mechanisms involved in the combination include combining the total number of operations and actions carried out by imagination, perception and thinking; The motivational component is expressed in the need to learn new forms and combinations of reality around a person, as well as to gain new experience and renew his mental formation.

In addition, there are several different types of combinatorial thinking. These are the following: Visual-figurative and visual-effective types; Productive and reproductive types; Theoretical and practical types.

This diversity is due to the fact that the type of thinking in question belongs to an independent form of intellectual activity. We will not go into the specifics of the categories, but instead talk about why combinatorial thinking should be developed.

Developing combinatorial thinking allows you to be logical, creative and analytical in your thinking. It helps us to see relationships and patterns between objects and events, and to find optimal solutions in complex situations.

The development of combinatorial thinking is very important in our life and in various fields of knowledge and it is very important for several reasons:

- a) Problem solving.** Combinatorial thinking helps us solve complex problems involving options, probability, and optimization. It allows us to analyze the situation, see connections and patterns between objects and events, find optimal solutions;
- b) Logical thinking.** The development of combinatorial thinking helps to develop logical thinking. We learn to analyze information, draw logical conclusions, build chains of reasoning and apply logical operations to solve problems;
- c) Creativity.** Combinative thinking develops our creativity and ability to think outside the box. We learn to see non-obvious connections and find non-standard solutions. It helps us to be more innovative and find new approaches to solving problems;
- d) Analytical skills.** Developing combinatorial thinking develops our analytical skills. We learn to break down complex problems into simpler components, analyze data, find patterns, and draw conclusions based on the results;
- e) Application in various fields.** Combinatorial thinking is widely used in various fields of knowledge, such as mathematics, computer science, physics, economics, etc. It helps us solve problems related to probability, registration, optimization, etc.

Combinatorial reasoning is based on several basic principles that help us analyze and solve combinatorics problems. Below are the following: **a) Calculation principle.** The counting principle states that in order to determine the number of possible combinations or permutations, it is necessary to consider all possible permutations of each element. For example, if we have 3 different fruits and we want

to choose 2 of them, then the total number of combinations will be $3 * 2 = 6$;

b) Order to principle. The ordering principle states that the order of elements in a combination is important. For example, if we have 3 different colors and we want to choose 2 of them, then the combination "red, blue" is different from the combination "blue, red";

c) Limitation principle. The principle of elimination states that in order to determine the number of combinations, it is necessary to eliminate the unwanted options. For example, if we have 5 different books and we want to choose 3 of them, but we do not want to add one of them to the combination, then the total number of combinations will be equal to the total number of combinations without this book;

d) The principle of collection. The summation principle states that the number of combinations for each individual case must be added to determine the total number of combinations.

For example, if we have 2 different fruits and we want to choose 1 of them or we don't want to choose any, then the total number of combinations is equal to the number of combinations to choose 1 fruit and the number of combinations to choose no fruit ladi

These are just a few of the basic principles of combinatorial thinking. Understanding and applying them will help us analyze and solve various problems related to combinatorics.

The results of the research show that while studying the work of Iranian mathematicians Roziya and Goya (2011) and English mathematician Lockwood on combinatorial thinking, there are five levels of combinatorial thinking, including the examination of "some cases", i.e. all How do I make sure I count the cases? how to use the counting procedure, how to systematically generate all the cases, and how to change the problem to another combinatorial problem. (Table 1)

The level of combinatorial thinking and its characteristics (Table 1).

<i>Combinatorial thinking level</i>	<i>General description</i>
<i>Some circumstances to determine</i>	<i>Students the problem complete they don't understand Students systematic process using problems solution to do possible , however results usually uncertain will be</i>
<i>Am I sure I've covered all the possibilities?</i>	<i>Students understand combination materials. Students can solve problems with systematic processes using tree diagrams and possibility grids</i>
<i>Calculated _from the rules use</i>	<i>Students count from the rules they use , that is to add and increase</i>

	<i>Students increase and to add the rules they understand</i>
<i>Systematically create all cases</i>	<i>Students can calculate without using charts, pictures or diagrams</i>
<i>Problems another combinatorial problem change</i>	<i>Students another combinatorial issues yesterday they get Students more complicated problems the calculations possible</i>

Methods of developing combinatorial thinking. The relevance of developing combinatorial thinking can be considered from several angles, but each of them is directly related to logic in one way or another: First, for the simple reason that the traditional educational system pays very little attention to logical thinking it is necessary to develop combinatorial thinking. As a result, for example, in schools, students make many logical errors, and adults often have problems organizing information logically. Combinatorial thinking helps overcome all of these; Secondly, the development of forms of combinatory thinking allows a person to search for the optimal combination of components of different situations and to find different options in completely different fields of activity (from communication to business). based on the individual elements of situations, as well as predicting the possible consequences of such combinations.

Based on this, it is very difficult to overestimate the importance of developing combinatorial thinking, because logic, imaginative perception, the ability to search for cause-and-effect relationships, thinking in general, etc. develop along with it.

Developing combinatorial thinking is an important aspect of teaching mathematics and logical thinking. There are several ways to help students develop combinatorial thinking: The first way to develop combinatorial thinking is to learn basic concepts and definitions. Students should understand what combinatorics is, combinatorial objects (eg, permutations, combinations, arrangements) and how they relate to each other; Solving combinatorics problems is a great and proven way to develop combinatorial thinking. Students should be able to analyze a problem, determine which combinatorial methods can be used, and apply them to find a solution; Creating combinatorial formulas is another way to develop combinatorial thinking. Students should be able to express combinatorial problems as formulas using suitable combinatorial objects and operations; Working with combinatorial models or using combinatorial models is another way to develop combinatorial thinking. Students can use different models such as trees, tables, diagrams or

probability grids to visualize combinatorial problems and better understand their solution; Solving problems related to real-life applications of combinatorics helps students see practical applications of combinatorial thinking.

All these methods help students to develop combinatorial thinking, increase their analytical and logical skills, solve and apply them to various problems and situations.

Practical application of combinatorial thinking. Combinatorial reasoning has a wide range of practical applications in various fields, including mathematics, computer science, economics, logistics, and others. The following are examples of practical applications of combinatorial thinking: **Mathematics.** In mathematics, combinatorial reasoning is used to solve problems related to combinatorics, probability, and number theory. For example, combinatorics can be used to determine the number of possible combinations or permutations of elements in a set, to solve placement and combination problems, to calculate the probabilities of various events; **Computer science.** In computer science, combinatorial reasoning plays an important role in developing algorithms and solving problems involving enumerating and generating combinations. For example, combinatorics can be used to generate all possible passwords of a given length, find optimal routes in traveling salesman problems, or solve graph coloring problems; **Economic sectors.** In economics, combinatorial thinking can be used to analyze different combinations of goods, services, or resources and determine optimal decision-making strategies. For example, combinatorics can be used to determine the number of possible orders for the production of a product, to optimize the allocation of resources, or to analyze investment options; **Logistics.** In logistics, combinatorial thinking can be used to optimize the processes of delivery, distribution and storage of goods. For example, combinatorics can be used to determine optimal delivery routes, calculate the number of possible options for packaging goods in a warehouse, or analyze options for placing goods on store shelves.

These are examples of practical applications of combinatorial thinking. In fact, combinatorics can be used in a variety of situations that require the analysis and optimization of combinations or permutations of elements.

Comparison table of methods of developing combinatorial thinking (Table

2)

Method	Description	Advantages	Disadvantages
Games and puzzles	Using games and puzzles to develop combinatory	<ul style="list-style-type: none"> • A fun and interesting way to learn 	<ul style="list-style-type: none"> • It can be difficult for some students • Requires games and

Method	Description	Advantages	Disadvantages
	thinking	<ul style="list-style-type: none"> • Develops logical thinking and creativity • It allows to use combinatorial methods in practice 	puzzles
Task analysis	Analysis and analysis of combinatorial problems aimed at the development of thinking	<ul style="list-style-type: none"> • It allows you to understand the basic principles of combinatorics <ul style="list-style-type: none"> • Improves analytical and problem-solving skills • Helps to develop logical thinking 	<ul style="list-style-type: none"> • It can be difficult for beginners • It takes time and effort to study and analyze tasks
Project assignments	Implementation of combinatorial projects for the development of thinking	<ul style="list-style-type: none"> • It allows to use combinatorial methods in practice • Develops creative thinking and creativity • Moore improves problem solving skills 	<ul style="list-style-type: none"> • Projects take time and effort to complete • It can be difficult for students without expertise in combinatorics

To teach combinatorial thinking, you can use a variety of tasks that help develop analysis, logic, and combinatorics skills. Here are examples of such tasks:

Issue 1. You have 4 t-shirts, 6 pairs of pants and 3 pairs of shoes. How many different outfit combinations can you make?

To solve this problem, it is necessary to increase the number of options for each item of clothing: 4 T-shirts * 6 pairs of pants * 3 pairs of shoes = 72 different combinations.

2 – issue. How many different passwords can be created using only the numbers 0 to 9 and having 5 characters?

To solve this problem, you need to consider that each password character can be one of 10 numbers. So, the total number of passwords will be $10 * 10 * 10 * 10 * 10 = 100000$.

3 – issue. You have 5 books of different genres and 2 shelves. How many different ways can you choose to arrange the books on the shelves?

To solve this problem, you need to use the principle of combinatorics. The number of ways to distribute the books on the shelves is $2^5 = 32$, since each book can be placed on one of the three shelves.

These are just examples of problems that can help teach combinatorial thinking. The more problems you solve, the better your skills and competence in this field will be.

Conclusions and recommendations

Combinatorial reasoning is an important intellectual skill that allows you to analyze and solve problems related to combinatorics and probability. The development of combinatorial thinking helps to develop logical thinking, creativity and abstract thinking. Basic principles of combinatorial thinking include permutations, combinations, and permutations. Methods for developing combinatorial thinking include teaching with case studies and real-life practical application. Combinatorial reasoning is widely used in various fields such as mathematics, computer science, economics, etc. Development of combinatorial thinking is an important task of education and helps students to develop analytical and creative thinking.

Conclusion, a few more words about the connection between combinatorial thinking and mathematics. Solving combinatorial problems, as it is already clear, has a special place in mathematics, and the role of this skill is becoming more and more serious. This is because such tasks have great potential for developing general thinking and learning to solve problems in everyday life.

In elementary mathematics courses, these problems are solved mostly by choice, and graphs and tables are often used to facilitate this process. In addition, the inclusion of combinatorial problems in mathematics courses is also related to the increasing developmental function of mathematics, because their solution involves a symbiosis of algorithmic and heuristic thinking styles. Here, the heuristic element is necessary to adequately perceive the problem, to find its solution, to create an algorithm for counting or identifying components, and the algorithm element is necessary for the competent execution of the constructed algorithm.

Thus, to teach combinatorial thinking, it is necessary not only to use special pedagogical methods, but also to turn to specialists with appropriate training.

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