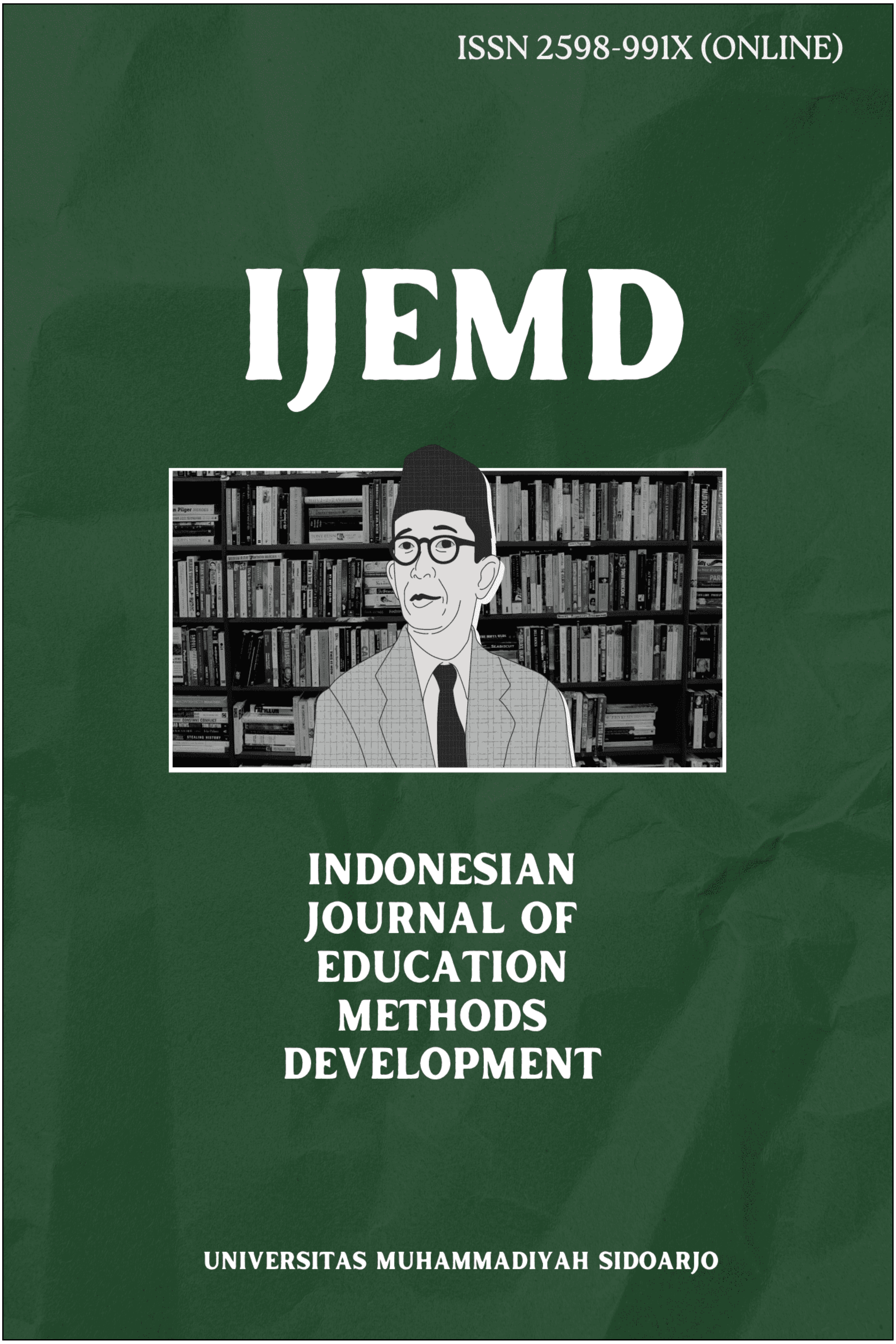
Indonesian Journal of Education Methods Development
Vol. 8 (2019): November
DOI: 10.21070/ijemd.v8i0.271 . Article type: (Elementary Education Method)

Table Of Content

ISSN 2598-991X (online), https://ijemd.umsida.ac.id/, published by Universitas Muhammadiyah Sidoarjo


ISSN 2598-991X (ONLINE)
IJEMD
INDONESIAN
JOURNAL OF
EDUCATION
METHODS
DEVELOPMENT
UNIVERSITAS MUHAMMADIYAH SIDOARJO

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ISSN 2598-991X (online), https://ijemd.umsida.ac.id/, published by Universitas Muhammadiyah Sidoarjo

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About teaching students to methods of solving problems by combinator

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Abstract

This article reveals some aspects of the formation of skills to solve combinatorial problems when studying a school course in mathematics. It also considers methods for solving historical combinatorial problems, combinatorial problems and the rule of multiplication, developing skills for solving combinatorial problems, tasks on forming concepts, a tree of options, factorial, applying equations to equations and simplifying expressions, combinatorial problems for studying the concepts of permutations without repetitions, permutations with repetitions, placements without repetitions, placements with repetitions, combinations without repetitions, combinations with repetitions. In mathematics, there are many problems that require elements make available a different set, count the number of all possible combinations of elements formed by a certain rule. Such problems are called combinatorial, and the branch of mathematics involved in solving these problems is called combinatorics. Some combinatorial problems were solved in ancient China, and later in the Roman Empire. However, as an independent branch of mathematics, combinatorics took shape in Europe only in the 18th century. in connection with the development of probability theory. In ancient times, pebbles were often used to facilitate calculations. In this case, special attention was paid to the number of pebbles that could be laid out in the form of a regular figure. So square numbers appeared (1, 4, 16, 25, ...). In everyday life, we often face problems that have not one, but several different solutions. To make the right choice, it is very important not to miss any of them. To do this, iterate through all possible options. Such problems are called combinatorial. It turns out that the multiplication rule for three, four, etc. tests can be explained without going beyond the plane, using a geometric picture (model), which is called the tree of possible options. It, firstly, like any picture, is visual and, secondly, it allows you to take everything into account without missing anything.

Published date: 2019-11-18 00:00:00

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Introduction

When studying combinatorics, one must first give students the historical aspects of the emergence of this branch of mathematics [1], [2]. Therefore, students can be told that the original concepts developed in ancient China, and then in Europe, during the period of the Roman Empire. Finally, as one of the branches of mathematical science arose in the 18th century. This was also facilitated by the study of scientific methods for solving problems associated with finding the probability of events. At that time, mathematicians were interested in the problem of finding formulas for calculating the so-called curly numbers, i.e. numbers that represented some specific geometric shape. For example, square numbers (1, 4, 16, 25, ...), could be represented using dots in the form of a square. So mathematicians found a formula for calculating such numbers . In the same way, the triangular formulas were found (1, 3, 6, 10,15, ...) as well as pentagonal (1, 5, 12, 22, . . .) accounts.

Formulation of the problem.

When discussing the formulas of these numbers, it is advisable to find the regularity of this numerical sequence by ourselves and make sure that they are correct for specific values of the natural variable and then invite students to solve the following types:

1. Finding according to the formula a certain specific number by the location and type of number, there are two parameters: place and type of number.

2. Solve the inverse problem by the number to find what kind this number belongs to the number

Then the students talk about the fact that in practice, sometimes there are moments or situations in which a person has to find the right choice from possible options [3], [4]. At the same time, he needs to make such a choice that this contributes to the solution of the proposed problem. In this case, all possible solutions to the posed problem [5], [6], [7] are checked.

The results of solving the problem.

When solving a problem with students, for example, you can count how many two-digit numbers using 2, 3 and 5, they will find with the help of a selection that there are exactly 9 of these numbers: 22, 23, 32, 33, 25, 35, 52, 53, 55. Therefore, it is important for students understand that in order to find the number of all possible options in the process of carrying out two independent experiments, it is necessary to find the products of the number of these two experiments.

For example, to make up of several different numbers, four-digit odd numbers, in which the numbers can be repeated, all possible options are calculated first for the number in the first place, and then for the number in the second place, etc. In the end, all these possible options are multiplied and the solution to the problem is obtained. For example, when finding the number of two-digit numbers made up of the numbers 1,3,5,7,9, we find: for the number 1: 11, 13,15, 17,19, for the number 3: 31,33,35, 37,39 , for the number 5: 51.53.55.57.59, etc. those. for each digit, 5 two-digit numbers and a total of such numbers will be 25 pieces. This pattern can be seen 52 = 25. Therefore, to continue this pattern, check how three-digit numbers can be composed of these five digits, the digits of which can be repeated. Hypothesis 53 = 125. Will it be true?

Now it will be clear to students that testing this hypothesis will involve them in a way to test the multiplication rule for any number of experiments that are looking for different options for solving the problem. When discussing the solution of a well-known problem in which it is required to find the number of possible seats for people, the number of which is equal to the number of seats, the numbers are first numbered, then there is the number of permutations for people to land these places. Such a quantity will decrease and using the above search rule of various options we will find the total number of landings depending on the number of seats and people landing, i.e. this hypothesis is obtained: the total number of permutations is equal to the product of all numbers from one to the total number of seats.

Discussions

To test this hypothesis, students are encouraged to solve problems with specific content. For example, the layout of a number of different letters one by one in envelopes or the number of handshakes of a certain number of friends, etc.

The process of studying methods for solving problems shows that the plot and plot of tasks are different, but the solutions obtained are presented in the same way. So students are reduced to the concept of factorial, that is, the product of the first numbers of the natural series $n! = 1 \cdot 2 \cdot 3 \cdot. . . (n-2) \cdot (n-1) \cdot n$. and the notation n !. It is important to emphasize that in mathematics it is accepted that $0! = 1$. Then it is proposed to calculate the first few values $1! = 1$, $2! = 1 \cdot 2 = 2$, $3! = 1 \cdot 2 \cdot 3 = 6$, $4! = 1 \cdot 2 \cdot 3 \cdot 4 = 24$, etc.

From here, the students can discuss the following question: if the set consists of n different elements, then how many ways can they be numbered using numbers from 1 to n. [8], [9], [10]

ISSN 2598-991X (online), https://ijemd.umsida.ac.id/, published by Universitas Muhammadiyah Sidoarjo

Results

Moreover, any such way of designating elements with numbering numbers from 1 to n is a permutation of the elements of a given set in which there are n elements. Here, the main attention should be paid to the fact that during each such method the elements of this set will be in a certain order, and thus, in the general case, the number of permutations P_n expressed by the formula, i.e. o is equal to the factorial of the number of elements in a given set.

To develop skills in using the factorial formula, you can give tasks to calculate a specific factorial value, problems of dividing a factorial by a given number, tasks to determine the number of zeros at the end of a factorial. Moreover, in the process of solving these problems, it is advisable to develop the skills of students not only to use the formula, but also the skills to apply them to solve other mathematical problems of a combinatorial nature [11], [12].

Conclusions.

When formulating a general definition of permutations, students need to pay attention to two signs of these permutations: firstly, they are made up of all the elements once, and secondly, these compounds differ in the order in which the elements are placed. Sometimes they are called combinations, sometimes compounds, but their meaning equally expresses the essence of this concept. In addition, with students it is necessary to find out that the number of permutations is justified on the basis of the multiplication rule. When consolidating this concept with students, it is possible to solve problems of a vital nature, i.e. tasks that are encountered in everyday life, when solving tasks of other objects, for example, tasks of determining the number of queues at a cash desk for receiving a product, ticket or doctor's appointment, for determining and compiling various numbers with a given number of characters from a certain number of digits or tasks for determining the number of ways of decomposing numbers into prime factors, the number of members of a product of a polynomial into a polynomial, geometry problems that require determining how to place a given number of points on a plane.

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