Modeling In The Process Of Solving Logic Problems

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Abstract: The article discusses the problems of constructing a mathematical model for solving logical problems and modeling techniques with a text-based argument chain, using a table, using graphs, using flowcharts, and also modeling techniques on a half-line.

Index terms: logical problem, mathematical model of the problem, modeling, modeling techniques in solving logical problems.

1. INTRODUCTION

One of the goals of the new state educational standard of the Republic of Uzbekistan [1] is the formation of the ability to learn from younger students. Achieving this goal in teaching mathematics requires, along with the introduction into school practice of new methods, means and forms of organizing the learning process, but also changes in the content and logic of the construction of some sections of the initial course of mathematics. In particular, the content and volume of studying text problems have also undergone changes, and other types of problems, including logical ones, were included in the curriculum of elementary school mathematics [2] along with traditional text problems.

The process of solving problems, including logical ones, fostering an interest in mathematics among younger schoolchildren allows them to develop such methods of mental activity as analysis, synthesis, analogy, generalization and concretization, flexibility and variability of thinking, teach children and critical reflection of the solutions. But the main feature of logical tasks is the development of the ability to briefly, clearly and correctly express your thoughts, i.e. their solution develops logical thinking, which contributes not only to a better understanding of mathematics, but also to the successful study of the foundations of any other science.

The solution of logical problems is largely heuristic in nature i.e. a unique way of solving, not typical of other tasks and therefore, a teacher in solving a specific problem can not always rely on previously formed knowledge and skills of students. Therefore, in the methodology of teaching logical problems, the role of focusing on general methods of activity is increasing, so that students become aware of some methods of solving and arming students with various options for modeling the process of solving logical problems. Since a text problem is a verbal description of a certain process, in order to solve it, one must translate it into the language of mathematical actions by constructing its mathematical model, i.e. describe the real process in mathematical language.

Allocate “... three stages of mathematical modeling:
I-stage - translation of the task into a mathematical language; at the same time, the data necessary for the solution are highlighted and the desired and mathematical relationships are described between them;
II-stage-intramodel solution (i.e. finding the value of an expression, performing actions, solving equations);
III-stage-interpretation, i.e. translation of the solution into the language in which the original problem was formulated”[11], [186].

Modeling is understood as the process of creating models and their use in order to generate knowledge about the properties, structure, relationships and relationships of objects [10].

At the same time, another object, in some respects similar to the one being studied, is selected or built to study a phenomenon or object; the constructed or selected object is studied and with its help solve research problems, and then the solutions of these problems are transferred to the original phenomenon or object [12].

An integral part of solving any text problem, which includes logical ones, is the construction of the model. The model, in this case, has the essential conditions and properties of the object under study. If we study this model, we will get a means to get an answer [13].
Since in the process of solving the logical problem is divided into additional questions and tasks feasible for younger students, the model will be the most effective means of finding a solution to the problem, although not every record will be a model. In order to build a model, you need to be able to distinguish values, a goal all relationships in a problem, in order to rely on it in the future and continue to solve it and find its optimal path based on it.

At the first stage of constructing a mathematical model, it is necessary to identify the dependencies between the sought and the data, and this is quite difficult. Therefore, to facilitate the construction of the model, that is, the process of solving the problem, the situation is transferred from the verbal model of the situation to the auxiliary one. To find the solution as soon as possible, they build schemes, make drawings, make tables, and only after that build a mathematical model of the solution, i.e. the auxiliary model is built for a more in-depth and effective analysis of the solution method and contains:

- Construction based on the analysis of the text of the task;
- Maximum approximation of abstract concepts to reality;
- Information on the essential features of the objects of the task in this particular case;
- The ability to directly detect the dependencies between the quantities referred to in the problem and allow the conversion of these quantities.

3. RESULTS AND DISCUSSIONS

There are a large number of typologies of logical problems, and many authors divide them into types in different ways [5], [6]. In the study [8], depending on the content, complexity level of logical problems and taking into account the age characteristics of primary school students, 8 types of logical problems were recommended that were recommended for inclusion in the initial course of mathematics. In the article, we consider examples of the use of models in solving logical problems in the initial course of mathematics.

1. The method of constructing a text chain of reasoning.

When solving logical problems with this technique, the conclusion of each of the arguments, except the last, is a premise in one of the following arguments.

Task 1. Kolya, Vasya and Sergey learned the multiplication table. One taught the multiplication table by 4, the second by 6, the third by 7. Who taught which table, if Vasya knew the multiplication table by 6, and Kolya by 4 and by 6. Solution. We single out the conditions of the problem. There are two of them:

1) Vasya knows the multiplication table by 6.
2) Kolya knows the multiplication table by 4 and 6.

From these conditions we derive the consequences by constructing a chain of reasoning:

- Kolya knows the multiplication table by 4 and 6. So he learns the multiplication table by 7.
- Vasya knows the table of multiplication by 6, therefore he could learn the table of multiplication by 4 and by 7. But the table of multiplication by 7 is taught by Kolya. So Vasya is teaching the multiplication table by 4.
- Then Sergey studies the multiplication table by 6.

1. In the condition of the problem, two judgments are considered, which allowed us to describe in detail the entire course of the small process of reasoning. But if there are several (more than 2) judgments in a logical problem, then it becomes difficult to verbally analyze the reasoning process, and therefore, tabular or graph construction is the rational way to format the results.

2. Acceptance of modeling using the table. If in the process of solving it is necessary to establish a correspondence between the elements of two or several different sets, then it is advisable to use a table. It makes the reasoning of the student more visual. The table field is the Cartesian product of these sets.

Consider the implementation of this technique on the example of solving the following logical problem from the manual [4], [62].

Problem 2. Arkady, Victor, Grigory and Sergey participating in a chess tournament. It is known that Victor did not take first place, Sergey received a prize for second place, Arkady did not take either first or last place. What place did each of the guys take? Decision. The problem considers two sets: the set of names of the guys and the set of places occupied by them. Between these sets it is necessary to establish a one-to-one correspondence. Let’s compile a table in which the rows are denoted by the names of the participants, and the columns by the numbers of the places they took. Let us single out the condition of the problem. There are three of them:

1) Victor did not take first place.
2) Sergey received a prize for second place.
3) Arkady did not take either the first or the last place.

We introduce these conditions into the corresponding cells of the table with the signs “+” (if compliance is fulfilled) or “-” (if compliance is not fulfilled). Since the correspondence between the sets is one-to-one, then in each row and each column of the table there must be a “+” sign and it should be only one.

<table>
<thead>
<tr>
<th>Name</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Arkady</td>
<td></td>
</tr>
<tr>
<td>Victor</td>
<td></td>
</tr>
<tr>
<td>Gregory</td>
<td></td>
</tr>
<tr>
<td>Sergey</td>
<td></td>
</tr>
</tbody>
</table>
From the conditions of the problem we derive the consequences and mark the results in the table with the signs “+” or “−”. Since each participant took a place, and each of the four places was taken by a participant, then:

1) if there is a plus in some cell, then in the other cells of the row and column at the intersection of which it stands, you must put a minus: Sergey’s second place in the table is marked with a plus sign, therefore we put a minus in the other corresponding cells.

2) in the line on which there are three minuses in the fourth cell, you must put a plus: Arkady took third place; therefore, put a minus in the other corresponding cells; also in the column in which there are three minuses in the fourth cell, you need to put a plus: Gregory took first place, therefore we put a minus in the other corresponding cells.

There was only one empty cell at the intersection of Victor and 4 columns. In the remaining cells of this row and this column there are minuses, therefore, you must put a plus in an empty cell - Victor took fourth.

It can be seen from the table that Grigory took the 1st place, Sergey the 2nd place, Arkady the 3rd place, and Victor the 4th place.

3. Reception modeling using graphs. Situations in which it is required to find a correspondence between elements of different sets can be modeled using graphs. In this case, the elements of the given sets are represented by points and the correspondence between them is represented by segments. If there is no correspondence between the elements of the sets, then they are connected by dashed lines.

If there is a one-to-one correspondence, each element of one of the sets will be connected by segments with only one element of the other sets, and with the rest of its elements it will be connected by dashed lines.

Consider the implementation of this technique on the example of solving problem 2. Using the condition of the problem we obtain on the graph, a visual image of the source data: we have many names of children and many places they occupy. We denote the elements of the first set by the letters A, B, C and D (capital letters of the names) of the second set by the numbers 1, 2, 3 and 4 (occupied places).

Since, by condition, Victor did not take first place, Arkady did not take either first or last place, then we connect the dashed line: (B and 1), (A and 1) and (A and 4). Sergey received a prize for second place, therefore, connect the elements (C and 2) with a segment. As a result, the following graph will be obtained:

Further from the conditions of the problem we derive the consequences and mark them on the graph: Arkady could take only 3rd place, Victor - 4th place. Connect the elements (A and 3), and also (B and 4), with segments.
on of flowcharts of reasoning are tasks for restoring the solution of problems in which it is necessary to draw conclusions correctly or restore conditions on conclusions.

Problem 4. One of the three coins (false) is different in mass from the rest. How to find it in two weighings on a cup scale without weights?

Solution: We compose a chain of reasoning:
1. Weigh coins 1 and 2.
2. If they are equal, then both coins are real, and false coin is 3.
3. If they are not equal, then one of them is false, and the third is real.
4. Weigh one of the suspected coins and the present. For example, coins 2 and 3.
5. If they are equal, then both coins are real, and fake coin 1. Otherwise, fake coin 2.

Tasks in which it is required to restore the condition develop the ability to build implicative reasoning. Implicative reasoning is the basis for solving logical weighing problems, but the final result should combine all the possible options into a single whole. This solution is more convenient and more visualized in the form of the following flowchart.

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4. CONCLUSION

Modeling, being one of the leading teaching methods in solving logical problems, helps equip younger students with such techniques that allow them to be active, successful, and not be afraid of difficulties when they work independently. At the same time, everyone chooses his own path of reasoning, modeling and, therefore, solving the problem.

REFERENCES: