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Zak A. Methods for determining the type of planning in younger adolescents

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Abstract. *The article presents a scenario for the interaction of fifth-grade students with a computer version of the author's methodology "Repetition" to determine the type of planning used in solving spatial-combinatorial problems. In the conditions of individual experiments with 23 students to test the proposed scenario, the possibilities of the computer version of the "Repetition" method in differentiation were shown types of planning among fifth graders: 65.2% of students used meaningful planning in solving problems, 34.8% used formal planning. In the future, it is planned to test the proposed scenario in work with sixth-graders and younger students, primarily with fourth-graders.*

Keywords: *fifth-graders, individual experiments, spatial-combinatorial tasks, types of problem solving planning, computer version of the "Repetition" methodology.*

1.Introduction.

The solution of the problem of the federal project "Digital Educational Environment" is associated with the creation of a modern and safe digital educational environment that ensures high quality and accessibility of education of all types and levels [4].

As part of the solution of the noted task, it is supposed to carry out not only the digitalization of the content of secondary school curricula, but also the development of digital technologies for diagnosing subject and meta-subject results of education, reflecting, in particular, the development of cognitive (cognitive) meta-subject competencies.

The provisions of the Federal State Educational Standard for Basic General Education [8] indicate that meta-subject educational results (including cognitive ones) are formed in primary school students as a result of studying the main educational program. At the same time, it is noted that cognitive meta-subject educational results reflect the development by students of various kinds of universal cognitive actions, associated, in particular, with independent planning to obtain the required result.

Studies show (see, for example, [1], [2], [7]) that problem solving can be planned in different ways. In one case, the first part of solution planning is a complete analysis of the conditions of the problem in order to determine all the specific executive actions necessary to achieve the desired result. In the second part of planning, a program is developed to achieve the desired result, in which all the necessary actions are included in a certain sequence. Only after this is the problem solved. In this case, planning is carried out as a meaningful action associated with programming the solution of the problem as a whole.

Otherwise, planning is done differently. Firstly, there is no complete analysis of the conditions of the problem and clarification of the composition of all actions necessary to obtain the required result, and, secondly, there is no independent part associated with drawing up a program for the implementation of all necessary actions.

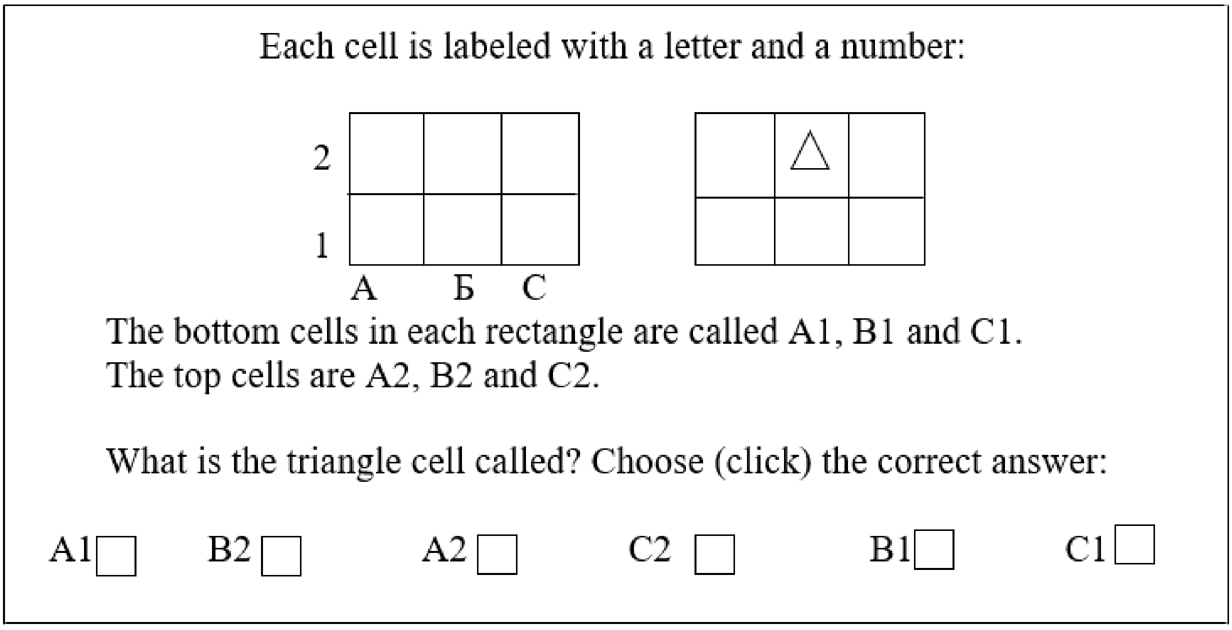
With this implementation of planning, one or two actions to solve the problem are first planned, then carried out, then again there comes a stage where actions are planned, and a stage where these actions are performed. In this case, in the course of planning, there is no construction of the entire sequence of necessary actions before their implementation, since first one part of the required sequence is outlined and carried out, then another part, and so on. Such planning is carried out as a formal action associated with programming the solution of a problem in parts.

2. Materials and methods.

The purpose of this study was to characterize the possibilities of the computer version of our technique "Repetition" [1, 5] in determining the type of planning in younger adolescents.

It was assumed that the developed scenario for the interaction of students with the computer version of the "Repetition" method really allows you to determine the type of planning (meaningful, in general or formal, in parts) when solving problems. In this, we proceeded from the fact that the computer version of the methodology was developed in such a way as to create conditions for solving problems that are as identical as possible to those conditions in which problems are solved in the original methodology (when developing this methodology, modern approaches to information and communication technologies for diagnostics of educational achievements of schoolchildren were taken into account [6]).

In the first part of working with the computer version (as in the original method, see [1]), students learn the names of the cells of the playing field. To do this, appropriate texts and images are placed on the computer screen.

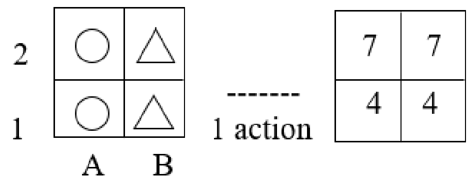


If the student chooses the wrong answer, the program informs him about it and offers the same question, but in this case the triangle is already in a different cell. And so it continues until the student gives two correct answers in a row.

In the second part of the work (the same as in the original method, see [1]), students solve training problems.

Problem 1

In which two cells do you need to swap the figures so that the same figures are in the same cells where there are the same numbers?



By pressing the buttons, write the names of two cells, for example,

like this: A1 ↔ B2

A B

1 2

In what other two cells can you change pieces?

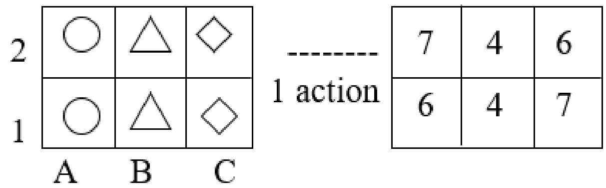
Find these cells and write their names ? ↔ ?

If the student chooses the wrong answer, the program informs him about it and offers the same question, but in this case the triangle is already in a different cell. And so it continues until the student gives two correct answers in a row.

If the student gives the wrong answer (writes down the wrong action), the program informs him about this and offers the second version of this task, where you also need to mentally place two pairs of identical figures in one action in such cells in which there are identical numbers. If the second version of the problem is solved incorrectly, then the experiment ends in this case.

In the case when the student (a) correctly solves the first option of the proposed problem or (b) the first option solves incorrectly, and the second one correctly, then he is offered the second (more difficult) training problem, with three pairs of figures and numbers. At the same time, just like the first task, it is required to find out in which two cells it is necessary to swap the figures in one action so that the same figures are in the same cells where there are the same numbers.

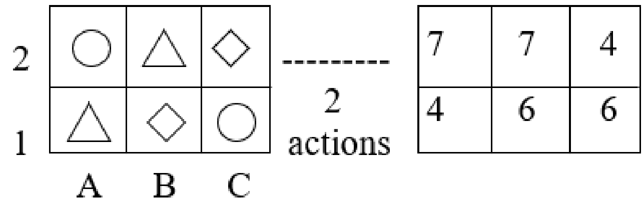
Problem 2



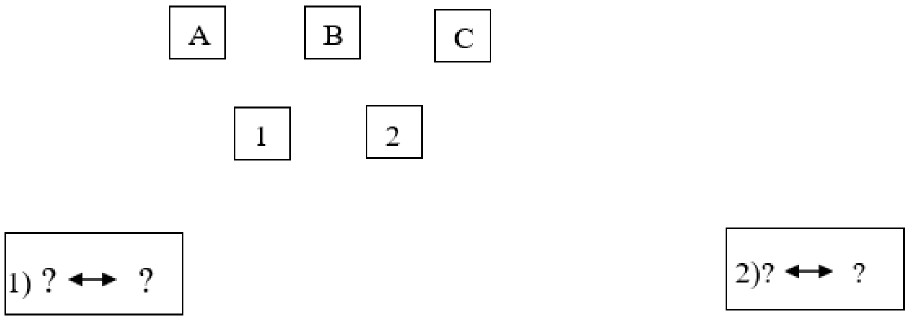
In the same way (presentation of one or two options), the solution of the third and fourth training tasks was programmed.

Problem 3

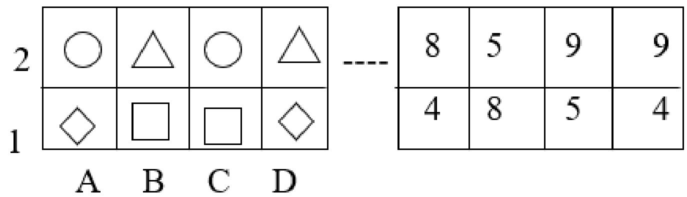
What two exchanges are needed so that the same figures are in the same cells, where there are the same numbers?



Press the buttons, write the names of the two cells of the first and second steps:

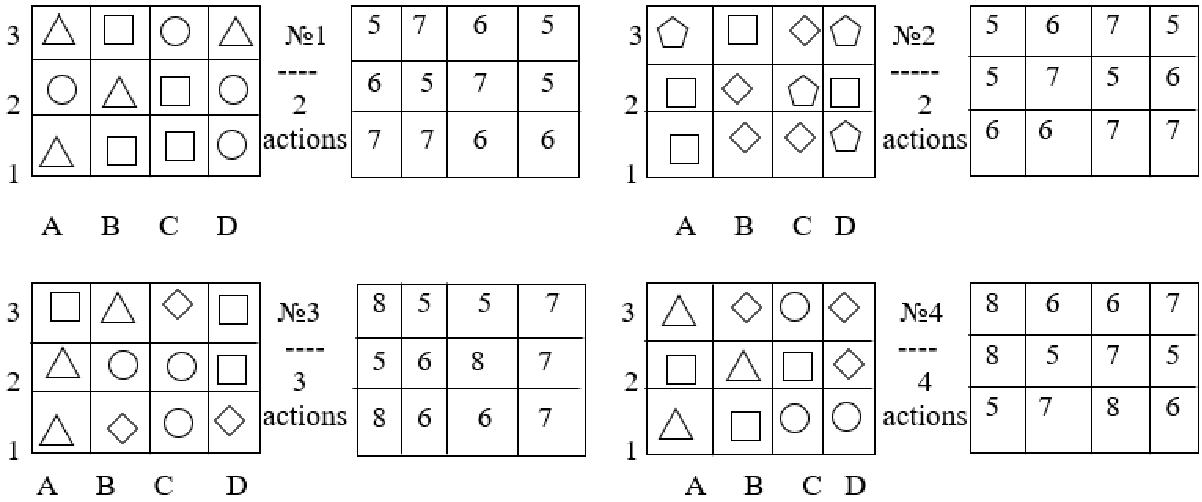


Problem 4



In the third part, students are invited to solve the same four main tasks as in the original methodology: Nos. 1 and 2 - in two actions, Nos. 3 and 4 - in three actions. Just as in solving training problems, students must find and write down the required actions by pressing the buttons with letters and numbers. The program does not report the result of solving each main task.

Main problems



3. Results.

In individual experiments with a computer version of the "Repetition" methodology, 23 fifth-graders participated in 4 and 5 grades. 15 people (group A, - 65.2%) successfully solved all the main tasks with the help of meaningful planning of their actions. The remaining eight people (Group B. - 34.8%) could not solve the main tasks in three actions (Nos. 3 and 4): four of them (subgroup B1) were able to correctly solve the first and second main tasks (in two actions), the other two (subgroup B2) - only the first main task.

Observations of the actions of students in both groups made it possible to characterize the features of solving problems with the help of meaningful and formal planning to achieve the desired result. It is important to note that the students were asked to think aloud, telling and explaining what and how they intend to do.

Thus, the students included in group A acted as follows. When solving each problem, the students, as could be understood from their words and actions, first found out the nature of the correspondence between the location of the figures (on the left side of the condition) and the location of the numbers (on the right side of the condition). In the first task, for example, they determined the following: the arrangement of triangles is most consistent with the arrangement of "fives", the arrangement of circles - the arrangement of "sixes", the arrangement of squares - the arrangement of "sevens"; in the second task: the location of rhombuses - the location of "sevens", the location of squares - the location of "sixes", the location of pentagons - the location of "fives".

After that, they figured out which two actions (two mutual movements of two figures) must be performed in order to solve the problem. Seven students of this group (subgroup A1) as the first action chose the exchange of places of a circle from cell D2 with a triangle from cell A1, two students (subgroup A2) chose to exchange places of a square from cell C1 with a circle from cell D2, one student (subgroup A3) chose as the first action, exchange the square from cell C1 with the triangle from cell A1.

When asked by the students of subgroup A1 about why they chose the intended first action, the students usually answered as follows: “... because three triangles are already in the places of the “fives”, and one triangle in cell A1 is in the place of the “seven” .. .. so you need to move this triangle to the place of the "five", in the cell D2 ... ".

When asked by the students of subgroup A2 about why they chose the exchange of places of the square from cell C1 with the circle from cell D2 as the first action, the students answered: “... because the circles should be where the “sixes” are, ... three circles already are in the places of the “sixes”, and one circle in the D2 cell is in the place of the “five”, ... therefore, put this circle in the place of the “six”, in cell C1 ... ".

In the same way, the student who made up the subgroup A3 answered the question about the choice of the first action: “... it is necessary that all the squares be in the places of the “sevens” ...”.

Then, based on the definition of the first action, the students of group A indicated a possible second action. For students of subgroup A1, this action was the exchange of places of a circle from cell A1 with a square from cell C1, for pupils of subgroup A2 – exchange of places of a triangle from cell A1 with a square from cell D2, for a student of subgroup A3 - exchange of places of a circle from cell D2 with a triangle from cell C1.

In a similar way, first determining the correspondence between the location of the figures and the location of the numbers (finding out in which places the largest number of certain numbers is located), then determining the content of the first and second actions, the students of group A acted in solving problem No. 2, and also and more complex main tasks (Nos. 3 and 4) – in three steps.

The noted actions of students of group A in solving basic problems of varying complexity give reason to believe that they carried out a meaningful cognitive action of planning a solution, associated with a complete analysis of the conditions of the problem and the definition of all the required actions in general before their implementation.

The students who made up group B acted differently. The students who solved correctly only the first and second main problems (group B1) did not find out (unlike the students of group A) the full correspondence between the location of the places (cells) occupied by the figures and the places occupied by the numbers.

When solving the first main problem, they immediately said that they needed to swap the circle from cell D2 with the square from cell C1. When asked why it was necessary to do this, they usually answered "... where there are two "sixes", there should be two circles ...". Then they wrote down this action: D2 – C1.

Next, they tried to determine what the second action might be. For a long time they examined and compared the arrangement of figures and the arrangement of numbers. As a result, they noticed that where two sevens are nearby (cells A1 and C1) there are a triangle and a square, and that it is necessary to put a square from cell D2 in place of the triangle in cell A1, so that, as they explained, "... the squares were in place "sevens"... Having found this solution, they wrote down the second action: A1 - D2.

As a result of performing these two actions, it turned out, unexpectedly for the students (as could be seen from their reaction), that the problem was solved: after the first action, all the circles were in the places of “sixes”, and after the second action, all the squares were in the places of “sevens”. ”And all the triangles are in the places of the “fives”.

In a similar way, the students of subgroup B1 solved the main problem No. 2.

When solving the main problem No. 3 (in three actions), the students of subgroup B1 acted in the same way as when solving the main problems No. 1 and 2. In particular, without finding out which figures correspond to the location of certain numbers, they immediately determined the first action . Seeing that in cells B3 and C3 there are two "fives", and in their places - a triangle and a rhombus, they considered it right to move the rhombus from cell B1 to cell B3, so that, as they explained: "... two rhombuses were there, where the two digits are 5...". After recording this action, they exchanged a rhombus from cell D1 and a triangle from cell A2: "... so that all the rhombuses are where the "fives" are...".

After recording the mentioned second action as the third action, she considered it necessary to move the square from cell A3 to cell D1, explaining: "... so that the squares are where the "sevens" are...".

By the next action, they were going to move the triangle from cell A2 to cell B2: "... so that all the triangles are where the "eights" are...". However, the experimenter reminded that this problem can be solved in three steps and offered to check what result was obtained after performing the found three mutual exchanges of figures in places. Checking the record of three actions showed that not all the figures are in the places of the corresponding numbers.

New attempts to solve this problem were as unsuccessful as the first attempt. When solving the fourth main problem, the students acted in the same way as when solving the previous (third) problem. As a result, it was solved incorrectly.

The actions of the students of subgroup B2 in solving the first main task were the same as those of the students of subgroup B1. It could be observed that the students do not find out the correspondence between the location of all the figures and the location of all the numbers and immediately write down the found variant of the interchange of two figures in order to have two identical figures in the places where two identical figures were found.

After the correct solution of the first main task, the second task was solved by them unsuccessfully.

The noted actions of the students of group B in solving the simplest basic tasks (Nos. 1 and 2) give reason to believe that they carried out a formal cognitive action of planning the solution of the problem, associated with a partial analysis of its conditions, with the definition and implementation of only one of the actions required for problem solving.

4. Conclusion.

So, our research, related to the conduct of individual experiments, consisted in approbation of the capabilities of the computer version of the "Repetition" method in determining the type of planning in solving problems in younger adolescents.

As a result of the experiments performed with 23 fifth-graders, it was shown that some students (65.2%) solve the problems of the computer version of the “Repetition” methodology using meaningful planning associated with a complete analysis of the conditions and determination of all required actions before they are performed.

Another part of the students (34.8%) used formal planning in solving problems, associated with a partial analysis of the conditions and the definition and implementation of each of the required actions.

Thus, the approbation showed that the computer version of the "Repetition" method allows you to determine the type of planning in younger adolescents, in particular, among schoolchildren studying in the fifth grade.

As further steps in testing this computer version of the "Repetition" methodology, it is planned to conduct a series of individual experiments with sixth graders.

Based on the analysis of the results obtained in experiments with pupils of the fifth and sixth grades, it will be possible to organize a survey of a relatively large number of pupils of the fifth and sixth grades. Such a survey is necessary to determine the age dynamics of the cognitive action of planning, the development of which is the content of a meta-subject educational result associated with independent planning of solving problems to obtain the required result.

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