WAYS OF CREATIVE THINKING OF YOUNGER STUDENTS

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Abstract. *The article reflects a study devoted to the study of the creative thinking of younger schoolchildren in the drafting of new tasks of a spatially combinatorial nature, solved according to the rules for rearranging the elements of conditions to an empty seat for a certain number of movements. Four main methods of composing tasks were identified and their distribution among students of the second and third grades was determined. It has been established that three-quarters of third-graders (9 years old) and only half of second-graders (8 years old) use meaningful and productive method of drafting problems. The obtained results testify to the fact that younger schoolchildren have a tendency to advance the use of the meaningful method in the drafting of spatial-combinatorial problems.*

Keywords: *creative thinking, junior schoolchildren, combinatorial problems, children 8 years old, children 9 years old.*

1 Introduction.

In 2009, a new Federal State Educational Standard for Primary General Education was approved [5]. The fundamental difference between this standard and the previous one is that the new primary school standard prescribes new criteria for evaluating its activities.

It states, in particular, that mastering the main educational program should lead to the achievement by younger students of meta-subject educational results of different content, since such results reflect the formation of three types of universal educational actions in children: cognitive, regulatory and communicative.

The content of one of the meta-subject educational results, which must be achieved as a result of education in the primary grades, is the formation in younger students of ways to solve problems of a creative nature. One of them is the problem associated with the independent compilation, composition, production of new tasks by children.

The purpose of this study was to establish the characteristics of the ways of creative actions of younger schoolchildren (in particular, students of the second and third grades) when independently compiling spatial-combinatorial tasks.

2. Materials and methods

The technique of these experiments included spatial-combinatorial tasks. These problems are situations where one arrangement of objects (objects, words, geometric figures, signs) needs to be transformed into another arrangement for the required number of actions (for more details on spatial-combinatorial problems, see our studies [2-5]. In the form of problems of this kind that was used in the present experiments, one arrangement of objects, the original one (it is represented on the three-cell playing field on the left) is transformed into another, required one (it is represented on the three-cell playing field on the right).

The transformation rule is that one action is the movement of any object (for example, a letter) to any free cell, for example, the movement of the letter D to an adjacent cell (fig. 1) or the letter F through a cell (fig. 2).

C | D |	----------	C | |D

Fig. 1. Problem condition with one permutation (var.1).

Fig. 2. Problem condition with one permutation (var.2).

2.1. First series of experiments.

In the experiments of the first series, such tasks were proposed to be solved and compiled in an external action plan, i.e., by moving cards with geometric figures depicted on them.

First, the child solved two training problems (Figures 3 and 4) in order to become familiar with the rules for rearranging objects in problems of this type. The condition of one problem was placed on two sheets of paper - each was half the size of a standard A4 sheet (i.e. 15 cm by 21 cm), since each cell was 5 cm by 5 cm. The child was told that for this problem, you want the cards with figures on the left to be arranged in the same way as the cards on the right. To do this, any card on the sheet (in cells) on the left can be rearranged into a free cell (Fig. 3 and 4).

Fig. 3. Training problem 1.

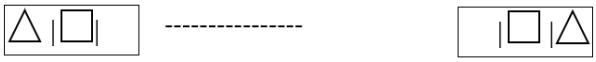

Fig. 4. Training problem 2.

In case of difficulties, the child was provided with the necessary assistance. Then the subject was offered the main task No. 1, where he also had to act on two playing fields (left and right), but each of them already had four cells, in which there were three cards with figures.

In problem number 1, it was required to find out: “What one permutation needs to be done so that the cards on the left are arranged like the cards on the right?” (see fig. 5).

In problem number 2, it was required to find out: “What two permutations need to be made so that the cards on the left are arranged like the cards on the right?” (see fig. 6).

In problem number 3, it was required to find out: “What three permutations need to be made so that the cards on the left are arranged like the cards on the right?” (see fig. 7).

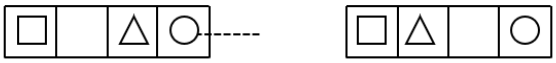

Fig. 5. Main problem 1

Fig. 6. Main problem 2

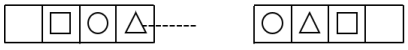

Fig. 7. Main problem 3.

It should be noted that, since all the indicated tasks were solved in this series of experiments in the external plan of action, the subject had the opportunity (in the process of

searching for a solution) to make trial permutations of any card in a free cell, i.e., favorable conditions were created for he could control his search activities.

At the third stage of the experiment, if the subject coped with tasks No. 1 and No. 2 (regardless of whether he coped with task No. 3), he was asked to compose tasks of the first degree of complexity (i.e., those where, as in task No. 1, you need to find one permutation). At the same time, to the left of him on the table there were sheets with left and right playing fields, on which the condition of problem No. 1 was presented.

For self-compilation of tasks, the child was offered two four cellular playing fields free from cards (fig. 8).

In addition, he was given cards with images of various geometric shapes (fig. 9).

Fig. 8. Playing fields.

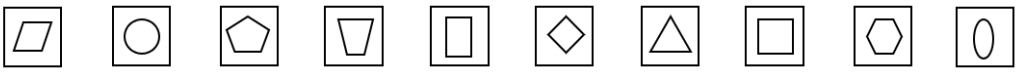

Fig. 9. Cards for drafting of problems.

The child was told: “Now you will come up with problems yourself, where you need to find one permutation. You have already solved this problem. Come up with as many problems as you want. Saying this, the experimenter pointed to the playing fields located on the table with the conditions of the main problem No. 1. Thus, the subjects were asked to come up with tasks of the first degree of complexity, similar to problem No. 1.

Both playing fields (Fig. 8) were located directly in front of the child and he was told: “Think about how you need to arrange the same cards in the cells on the left and right, so that in one permutation the cards on the left would be in the same cells as on the right. This will turn out to be a problem where you need to find one permutation.

When composing problems, the subjects acted differently. The first group implemented a formal approach in their actions, composing problems that could not be solved by making only one permutation.

As a rule, these children made up problems not of the first, but of the second degree of complexity (that is, those where it is required to find two permutations, and not one, as was suggested to the subjects), - fig. 10.

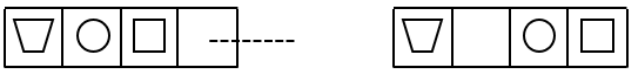

Fig. 10. Problem of the second degree of complexity.

Their actions outwardly corresponded to what the experimenter demonstrated to them at the beginning of the experiment, offering problems for solving: after looking at the condition of problem No. 1, the children also arranged cards on the left and right playing fields and placed them differently on the left and right.

However, since, as one could observe, they themselves did not solve the invented problems, situations were obtained that did not meet the requirement "... problems should be solved in one permutation ...".

The second group of children acted differently and, as a result, they were able to propose a problem that could be solved with the help of one permutation. Unlike the subjects of the first group, who simply looked at the condition of problem No. 1 and saw there that the same cards were placed on the left and right, the subjects of the second group acted as follows. They, as could be observed, first

noted in the condition of the problem №1 that one card changed its place. After that, they first placed some three cards on the left playing field, and then the same cards and, what is especially interesting, in the same cells on the right playing field (fig. 11).

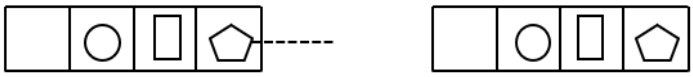

Fig. 11. The initial stage of problem drafting.

And only after that, on the playing field on the right, they rearranged a card with a pentagon into a free cell, thereby obtaining the desired problem (fig. 12).

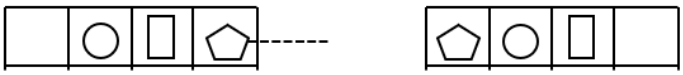

Fig. 12. The final stage of problem drafting.

Such an approach to composing problems can be qualified as meaningful, since, as can be observed, the subjects of this group were not satisfied with any arrangement of cards, but only with one that allows you to get a problem that can be solved in one permutation, i.e. a problem that meets the requirements proposed experimenter.

The children of the third group also used a meaningful approach when compiling tasks, but they acted differently than the children of the second group. The children of the third group did not arrange the cards in the same way on both playing fields (as the children of the second group did), and after placing three cards on the left playing field, they immediately placed one card (hexagon) in a different way on the right playing field, and the other two in the same way as they were located on the left playing field (fig. 13).

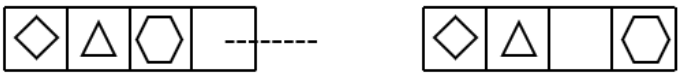

Fig. 13. An example of problem drafting.

After that, the sheet with the playing fields and the condition of the first formulated problem was put aside and the child took two more sheets with playing fields. He compiled the second problem, looking at the first, and also operated with cards.

I wonder what in which way groups were not one - two problems (as children of the second group), and three - five problems. At the same time, all tasks were solved in the same way, by rearranging the card into a free cell, which is also in the same place in all problems (fig. 14).

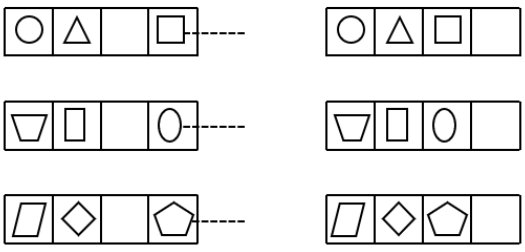

Fig. 14. An example of productive problems drafting.

The approach to composing problems that children of the third group have can be qualified as productive, since, acting in the same meaningful way as the children of the second

group (i.e., compiling correct, solvable problems), the children of the third group showed more efficiency in composing problems, coming up with three to five new options.

The children of the fourth group acted partly in the same way as the children of the third group, but on the whole in a different way. So, when compiling the first problem, the children of the fourth group, just like the children of the third group, placed the cards first on the left playing field, and then on right, while changing the location of one of the cards. But already when compiling the second and subsequent tasks, the children of the fourth group performed new actions, trying either to choose a place for a free cell so that it would be located differently in different problems (Fig. 15), or to make different permutations: in a neighboring cell (problem A), through two cells (problem B) or through one (problem C).

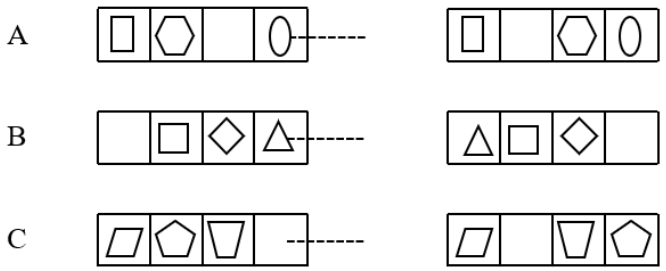

Fig. 15. An example of original problems drafting.

Thus, in the children of both the fourth and third groups, several (from three to five) problems were composed, but the children of the third group made up the same tasks, and the children of the fourth group were different. It can be said, therefore, that the children of the fourth group showed not only productivity in composing problems, but also originality, each time composing a problem that was not like the others.

2.2. Second series of experiments.

In the experiments of the second series, the children solved and composed tasks in the external action plan (similarly to how it happened in the experiments of the first series). However, in the second series (unlike the first series), it was proposed to compose problems of the second degree of complexity, i.e., those where two permutations had to be made.

At the same time, only those children who could solve the problem of the third degree of complexity, i.e., with three permutations, were selected to participate in the experiments of the second series, while those children who could not cope with the problem of the third degree could also participate in the first series. degree of difficulty.

After solving the problems, the children were asked to compose problems with two permutations. At the same time, the condition of task No. 2 was left on the table to the left of the child.

When compiling the tasks, the same four groups of subjects stood out as in the first series of experiments.

The children of the first group acted formally: they simply looked at the condition of problem No. 2 and then arranged the same cards in the cells on the left and right, receiving the conditions of problems that could not be solved in two permutations.

Some of the children in this group (subgroup A) made up problems that could be solved in one permutation (fig. 16).

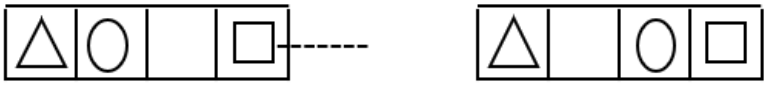

Fig. 16. Problem with one permutation.

Other children (subgroup B) made up tasks that could be solved only in three permutations of the cards (fig. 17).

Fig. 17. Problem with three permutations.

Children of the second group acted meaningfully, composing one or two problems that could be solved in two permutations. At the same time, they acted in the same way as the children of the second group in the experiments of the first series: first they studied the condition of problem No. 2, noting, as could be observed, the presence of two cards that had changed their place, then they placed three cards on the left playing field, and after that the same three cards and exactly in the same cells - on the right playing field.

Next, on the right playing field, they first rearranged one card into a free cell (Fig. 18), and then rearranged another card into the vacant cell (Fig. 19):

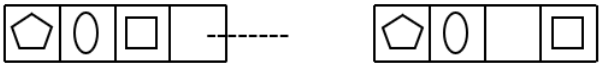

Fig. 18. The initial stage of problem drafting.

Fig. 19.The final stage of problem drafting.

The children of the third group acted productively, composing several monotonous problems (Fig. 20). At the same time, they acted in the same way as the children of the third group when compiling problems in the first series, taking the first problem as a model.

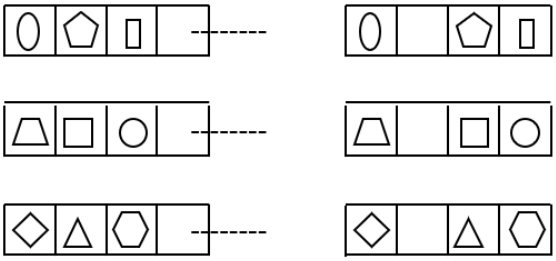

Fig. 20. An example of productive problems drafting.

The children of the fourth group acted in an original way, composing several different tasks, trying, like the children of the fourth group in the first series, to have a free cage in a different place (fig. 21).

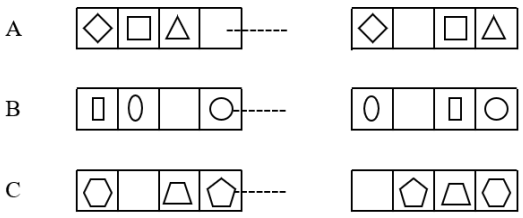

Fig. 21. An example of original problems drafting

As you can see, in problem A in the left location, the free cell was the one on the right, in problem B it was the second one on the right, and in problem C it was the second one on the left.

It should be noted that both the children who acted productively and the children who acted in an original way constituted not only three new tasks, but often four or even five problems.

2.3. Third series of experiments.

In contrast to the experiments of the first and second series, in the experiments of the third series the children solved problems internally. This means that after solving two training tasks (Fig. 3 and 4), which was carried out by rearranging the cards, when solving the main problems No. 1, No. 2 and No. 3, the cards were not rearranged, remaining in their places.

To perform the rearrangement, the children only named the images of geometric shapes on the cards that were planned to be rearranged. So, when solving a problem with two permutations, the subject could say: "... first you need to rearrange the square, then the circle ...".

In connection with the noted features of the organization of the process of solving the main problems, their conditions were presented to the child not on two sheets of cards (as was the case in the first two series), but on one sheet, where two playing fields were drawn on the left and right sides and three geometric figures in four cells on each.

In this series, it was proposed (as in the first two series) to solve problems with one, two and three permutations, i.e., respectively, No. 1 (Fig. 5), No. 2 (Fig. 6), No. 3 (Fig. 7). If the subject managed to cope with solving problems not only with one, but also with two or three permutations, then he was asked to further compose problems with one permutation (of the first degree of complexity). At the same time, to the left of him on the table (as it was in both previous series) there was a sheet with the condition of the main task No. 1 drawn on it.

When compiling problems, it was necessary to act in an internal plan (that is, to operate only with the images of the figures placed on the cards, and not with the cards themselves with the images of these figures). Therefore, the children were given not such playing fields as in the first two series of experiments, but such, where each cell was marked with a number (fig. 22).

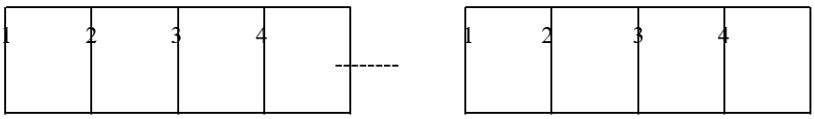

Fig. 22. Playing fields for mental of problems drafting.

Along with these playing fields, the child also had three cards with geometric shapes - an oval, a pentagon and a rectangle. To compose a new problem, new fields and three other cards were given.

In the course of compiling problems, the subjects had to name the figures on the cards and the numbers of the cells where it was required to place this or that figure.

Just as in the previous two series, the subjects composed tasks in different ways: one group of subjects acted formally (composing problems that could not be solved in one permutation), the second acted meaningfully (studying problem No. 1 and solving the formulated task), the third - acted productively (each time repeating the structure of the first formulated problem) and the fourth acted in an original way (changing the place of a free cell in the problems).

2.4. Forth series of experiments.

In the experiments of the fourth series, as well as in the experiments of the third series, the subjects solved and composed tasks in the internal action plan (except for training problems). But for the formulation of tasks (in contrast to the situation characteristic of third series), only those children were selected who could solve problem No. 3, the third degree of complexity, with three permutations.

These children were asked to compose tasks of the second degree of complexity, with two permutations. At the same time, they were asked to act in the same way as in the third series: to name the images of geometric figures on the cards and the numbers of the cells on the playing fields, where it was supposed to place cards with certain geometric figures.

In the fourth series (as in the three previous ones), the subjects composed problems in different ways: one group composed problems formally (i.e., problems were obtained that could not be solved in two permutations), the other group acted meaningfully (made up one or two two permutations), the third group acted productively (consisted of three to five identical problems), and the fourth group acted in an original way, composing from three to five different problems.

3. Results

A total of 212 junior schoolchildren participated in the study. Of these, 105 students of the second grade: 27 people participated in the first series, 24 in the second, 29 in the third, 25 people in the fourth, and 107 students of the third grade: 29 people participated in the first series, 25 in the second, and 27 in the third , in the fourth - 26 people.

Table 1. The number of students in the second grade who made up spatial-combinatorial problems formally, meaningfully, productively and in an original way in each of the four series of experiments (in %).

Ways drafting problems	Series of experiments			
	First	Second	Third	Fourth
Formal	3,7	8,4	34,5	40,0
Meaningful	33,3	33,3	37,5	36,0
Productive	48,2	45,8	24,1	16,0
Original	14,8	12,5	3,9	0,0

Table 2. The number of students in the third grade who made up spatial-combinatorial problems formally, meaningfully, productively and in an original way in each of the four series of experiments (in %).

Ways drafting problems	Series of experiments			
	First	Second	Third	Fourth
Formal	6,9	8,0	22,2	23,1
Meaningful	7,1	20,0	25,9	38,5
Productive	62,1	56,0	44,5	34,6
Original	24,1	12,0	7,4	3,8

Analysis of the data presented in tables 1 - 2 allows us to formulate a number of provisions.

So, in the second grade, the number of children who acted in a formal way increases with each series. A particularly sharp increase in the number of children in this group is observed in the third series, in relation to the second, respectively: 34.5% and 8.4%. It can be assumed that this sharp increase is associated with a change in the form of action in the preparation of problems: the subject-effective form (rearrangement of cards by hands) changes to a visual-figurative one (rearrangement of cards by hands is excluded). At the same time, the increase in the number of children from the first series to the second and from the third series to the fourth is smaller, respectively: 3.7% - 8.4% and 34.5% and 40.0%.

Table 1 also shows that the number of children who acted in a meaningful way increases slightly from the first series to the fourth (compared to the number of children who acted in a formal way), by 2.7% (from 33.3% to 36.0%). One noticeable increase in the number of children in this group is observed from the second series to the third series: by 4.2% (from 33.3% to 37.5%). These data indicate, in our opinion, that in the sec-

ond grade, approximately one third of the children have mastered the meaningful method of composing problems.

The number of children who acted in a productive way decreases with each series. A particularly sharp decrease in the number of children in this group is observed in the third series, in relation to the second, respectively: 24.1% and 45.8% (i.e., the decrease is 21.7%). Just as when considering the changes in the number of children who acted in a formal way, it can be assumed that such a sharp decrease is associated with a change in the form of action in the preparation of tasks: the object-active form changes to a visual-figurative one. At the same time, the decrease in the number of children from the first series to the second and from the third series to the fourth is smaller, respectively: 48.2% - 45.8% and 24.1% and 16.0%.

The number of children who acted in an original way, as well as the number of children who acted in a productive way, decreases with each series. A particularly sharp decrease in the number of children in this group (as well as children in the previous group) is observed in the third series, in relation to the second, respectively: 12.5% and 3.9% (i.e., the decrease is 8.6%). As in the previous cases, this decrease is associated with a change in the form of action in the preparation of tasks: the object-active form changes to a visual-figurative one. At the same time, the decrease in the number of children from the first series to the second and from the third series to the fourth is smaller, respectively: 14.9% - 12.5% and 3.9% and 0.0%.

So, considering the change with each series of experiments in the number of children from different groups in the second grade (children who acted in formal, meaningful, productive and original ways), it should be noted that while the number of children who acted in a meaningful way, changes little from the first series to the fourth by 2.7% (from 33.3% to 36.0), the number of children in the other three groups changes quite noticeably. Thus, the number of children acting in a formal way changes by 36.3% (from 3.7% to 40.0%), the number of children acting in a productive way - by 32.2% (from 48.2% to 16.0%) the number of children who acted in an original way - by 14.8% (from 14.8% to 0.0%). At the same time, it is important to emphasize that the number of children who acted in a formal way is increasing, while the number of children who acted in productive and original ways is decreasing.

In the third grade, the number of children who acted in a formal way, just as in the second grade, increases from the first series to the fourth, but by a smaller amount - by 20.0%. A particularly sharp increase in the number of children in this group (as in the second grade) is observed in the third series, in relation to the second, respectively: 22.2% and 8.0%. It can be assumed that this sharp increase is associated with a change in the form of action in the preparation of tasks: the subject-effective form (rearrangement of cards by hands) changes to a visual-figurative one (rearrangement of cards by hands is excluded). At the same time, the increase in the number of children from the first series to the second and from the third series to the fourth is smaller, respectively: 6.9% - 8.0% and 22.2% - 23.1%.

Table 2 also shows that the number of children who acted in a meaningful way increases from the first series to the fourth, in contrast to what is observed in the second grade, significantly: by 31.4% (from 7.1% to 38,5%). At the same time, the largest increase is observed from the third series to the fourth: by 12.6%, while the increase from the first series to the second is 8.9%, and from the second to the third - 9.9%.

It can be assumed, analyzing the noted data, that the change in the number of children from series to series turns out to be not associated either with a change in the complexity of the tasks being compiled (from the first to the second series and from the third series to the fourth), nor, in contrast to the situation in the second grade, with a change in the form of action in the preparation of tasks (from the second series to the third).

The number of children who acted in a productive way, as in the second grade, decreases with each series, and a particularly sharp decrease in the number of children is observed in the third series, in relation to the

second, respectively: 44.5% and 56.0% (i.e., a decrease is 11.5%). As when considering the situation in the second grade, it can be assumed that such a decrease is associated with a change in the form of action in the preparation of tasks: the subject-effective form changes to a visual-figurative one. At the same time, the decrease in the number of children from the first series to the second and from the third series to the fourth is smaller, respectively: 62.1% - 56.0% and 44.5% and 34.6%.

The number of children who acted in an original way, as well as the number of children who acted in a productive way - just like in the second grade - decreases with each series. A particularly sharp decrease in the number of children in this group (as well as children in the previous group) is observed in the third series, in relation to the second, respectively: 7.45% and 20.0% (i.e., the decrease is 12.6%).

As in the case of previous cases, this decrease is associated with a change in the form of action in the preparation of tasks: the object-active form changes to a visual-figurative one. At the same time, the decrease in the number of children from the first series to the second and from the third series to the fourth is smaller, respectively: 24.1% - 20.0% and 7.4% and 3.8%.

So, considering the change with each series of experiments in the number of children of different groups in the third grade (children who acted in a formal, meaningful, productive and original way), it should be noted that while the number of children who acted in a formal way and in a meaningful way, from the first series by the fourth increases, respectively: by 16.2% and 31.4%, the number of children of the remaining two groups – acting in productive and original ways – decreases, respectively: by 31.5% and 20.3%.

4. Conclusion

On the whole, when comparing the distribution of children who formulated tasks in different ways in the second and third grades, it should be noted that in the third grade (compared to the second grade) the number of children who acted, in particular, in the fourth series, in a formal way, decreased significantly - by 16.9% (from 40.0% to 23.1%) and the number of children who acted in the same series in a productive way increased significantly - by 18.6% (from 16.0% to 34.6%). In contrast, the number of children who acted in the fourth series in meaningful and original ways increased slightly, by 2.5% and 3.8%, respectively.

Thus, it can be assumed that in relation to the compilation of spatial-combinatorial problems, primary school age (in particular, children aged 8-9 years old, studying in the second and third grades) is the leading one for the formation of productive and original methods in the conditions of compiling tasks in a subject-effective form.

The conducted research made it possible to establish the nature of the distribution of methods for composing spatial-combinatorial problems among students of the second and third grades. The data obtained indicates the number of children in each class who made up the tasks in a formal, meaningful, productive and original way.

It has been shown that with age, the number of children who cannot compose correct, solvable problems decreases (these children act in a formal way) and the number of children who can compose one or two solvable problems increases (these children act in a meaningful way).

Also, with age, the number of children who are able to compose three to five correct tasks that are identical in a specific way of solving (these children act productively) and three to five correct tasks that require a different specific way of solving (these children act in an original way) increases with age.

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СПОСОБЫ ТВОРЧЕСКОГО МЫШЛЕНИЯ МЛАДШИХ ШКОЛЬНИКОВ

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Аннотация. *В статье отражено исследование, посвященное изучению творческого мышления младших школьников при составлении новых задач пространственно-комбинаторного характера, решаемых по правилам перестановки элементов условий на свободное место за определенное количество движений. Выявлены четыре основных способа составления заданий и определено их распределение среди учащихся вторых и третьих классов. Установлено, что содержательный и продуктивный метод составления задач используют три четверти третьеклассников (9 лет) и только половина второклассников (8 лет). Полученные результаты свидетельствуют о том, что младшие школьники имеют тенденцию опережать использование содержательного метода при составлении пространственно-комбинаторных задач.*

Ключевые слова: *образное мышление, младшие школьники, комбинаторные задачи, дети 8 лет, дети 9 лет.*