METHODS FOR PRODUCING LOGICAL PROBLEMS FOUR-GRADE SCHOOL

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Abstract. The article presents a study aimed at studying the features of the creative actions of fourth-graders in the preparation of logical problems. The main methods of creative actions are characterized: formal, meaningful and productive. The distribution of these methods among fourth-graders has been established. The study showed that the majority of fourth-graders use a meaningful method when compiling logical problems.

Keywords: *the fourth grade students; logical problem; methods of producing: formal, meaningful and productive.*

1. Introduction. The development of problems related to the creative mental activity of younger schoolchildren is an important area of psychological and pedagogical research. In the new Federal State Educational Standard of Primary General Education, primary education is tasked with assessing the quality of education based on determining the degree of achievement of meta-subject educational results. In particular, it is pointed out that one of the essential metasubject results is the ability to solve problems of a creative nature [5]. This ability is manifested, in particular, in the production, composition of new tasks by children, in the development of creative mental activity by them.

In our earlier study [4], in a series of individual search experiments with younger schoolchildren of different ages, we used a methodology that included logical tasks, the content of which reflects a certain life situation.

For example: “Misha, Sasha and Nina fled to the races. Nina ran earlier than Sasha, and Sasha ran earlier than Misha. Which of the students ran the slowest of all?”

Tasks of this kind, i.e. tasks with a plot, in contrast to tasks without a plot, i.e. abstract-logical, for example: “A is greater than B, B is greater than C. What is the largest, A, B or C?”, – can be called concrete-logical (more about concrete-logical tasks, i.e. tasks with some history, with a certain plot, see our studies [1, 2, 3]).

During the experiment, each child had to first solve a specific logical problem, and then compose or produce similar problems. The experiments carried out made it possible to characterize three methods for composing concrete-logical problems.

One way is related to the fact that students come up with unproblematic and unsolvable problems. In some cases, they offer such problems, where the required part of the condition is (these are non-problem problems). For example: “Masha, Vera and Olya were swimming across the river. Vera swam faster than Olya. Masha swam faster than Vera. Who swam faster than Vera?”

In other cases, students proposed problems in which no conclusion can be drawn based on the information given in the condition (these are unsolvable problems). For example: “The bee flew higher than the dragonfly. A mosquito flew faster than a fly. Who flew the fastest?”

Another way is related to the fact that students offer one or two tasks, approaching production actions in a meaningful way, i.e. taking into account that what is sought, firstly, does not repeat the condition, and, secondly, that the problem has a solution.

For example, the first task: “Nikolai, Svetlana and Sergey had animals at home. Someone had a cat, someone had a hamster, someone had a dog. Svetlana didn't have a dog. Sergei did not have a dog or a cat. At who was the hamster?” The second task: “Petya, Borya and Alik got to school by different means of transport. Someone on the bus, someone on the trolleybus, someone on the subway. Borya did not ride the bus. Petya did

not travel by bus or subway. Who rode the subway?"

The third way is related to the fact that students also offer solvable problems, but not one or two, as in the previous case, but three or five similar problems. Here, therefore, students approach the production of tasks not only meaningfully, but also productively.

For example, the following three tasks.

The first task: "Borya, Gena and Vasya were shooting from a bow. Borya shot better than Gena. Gena shot better than Vasya. Who shot the best?"

The second task: "Vera, Nina and Vika ate porridge. Vera ate faster than Nina. Nina ate faster than Vika. Who ate the fastest?"

The third task: "Katya, Misha and Sveta jumped high. Katya jumped higher than Misha. Misha jumped higher than Sveta. Who jumped the highest?"

2. Materials and methods

The present study was aimed at establishing how many fourth-grade students produce non-problematic and unsolvable tasks, how many students produce tasks using a meaningful way, how many students produce tasks using a productive way.

Four series of individual experiments were carried out.

In the first series, it was necessary to solve problems of the first, second and third degree of complexity and produce problems of the first degree of complexity in a visual-figurative form.

In the second series it was necessary to solve problems of three degrees of complexity and produce problems of the second degree of complexity in a visual-figurative form.

In the third series it was necessary to solve problems of three degrees of complexity and produce problems of the first degree of complexity in a verbal-sign form.

In the fourth series it was necessary to solve problems of three degrees of complexity and produce problems of the second degree of complexity in a verbal-sign form.

Thus, the series of experiments differed both in terms of the conditions for solving and producing tasks (i.e., in a visual-figurative form or in a verbal-sign form) and in their complexity - here we mean the number of judgments that need to be compared in order to first find a solution to the problem, and then come up with new problems based on it.

A total of 112 students of the fourth grade participated in four series of experiments: in the first series – 28 people, in the second – 27, in the third – 29, in the fourth – 28.

2.1. First series of experiments

As noted, the meaning of the first series was to, according to the requirements of the experimenter, first solve problems of the first and second degrees of complexity, and then come up with problems of the first degree of complexity. It was necessary to solve and invent problems in a visual-figurative form. The last condition meant that when composing problems it was possible to use cards with pictures. On one part of the cards there were various drawings of children: boys and girls, in different clothes, doing different activities. On the other side of the cards were drawn a variety of objects that are widely used in different situations: on the streets of cities, at home, in schools and other places.

First of all, the student received a sheet of paper on which was the text of the problem: "Alla and Vera bought writing materials. Someone bought an eraser, someone bought a notebook. Allah bought a notebook. What did Vera buy?" This problem had to be read and answered. In case of an incorrect solution of this problem, the experiment with the student ended.

In the case of a correct solution to this problem, the student was given three more tasks (basic): No. 1, No. 2, No. 3. At the same time, the first task was of the first degree of complexity, the second – of the second degree, the third - of the third degree of complexity. The text of each task was printed in large print and placed on a separate sheet.

The first to solve problem number 1: "Sveta and Gena read stories: someone about birds, someone about fish. Sveta did not read stories about fish. About whom did Gena read stories?"

Since there are two characters in the condition of this problem and it is possible to draw a conclusion by comparing one particular judgment (the second sentence of the problem) with the general judgment (the first sentence of the problem), it was assumed that

this problem is of the first degree of complexity.

If this problem was solved incorrectly, the experiment with the child was terminated. With the correct solution of this problem, the student was given the opportunity to cope with task No. 2: “Masha, Vika and Dasha were peeling fruit for compote. Someone peeled oranges, someone tangerines, someone grapefruits. Masha peeled oranges, Vika did not peel tangerines. What did Dasha cleanse?”

There are three characters in the condition of this task, and the conclusion can be made by comparing two particular judgments (the third and fourth sentences of the task) with the general one (the second sentence of the task). This circumstance determines the qualification of this task as a task of the second degree of complexity.

With the correct solution of the second main task, it was possible to solve the third main task: “Sasha, Vika, Nadya and Tanya traveled. Someone went to Orsk, someone to Vorkuta, someone to Syzran, someone to Kirov. Sasha flew to Orsk, Vika flew to Vorkuta, Nadia did not fly to Syzran. Where did Tanya go? There are four characters in the condition of this task, and the conclusion can be made by comparing three particular judgments (the third sentence of the task) with the general one (the second sentence of the task). This circumstance determines the qualification of this task as a task of the third degree of complexity.

If the student correctly solved problem No. 2, then he was instructed to come up with problems of the first degree of complexity, where there were two characters: “Try to come up with tasks in which two people did something. You have already managed to solve this problem. Write as many problems as you can." For composition, the student was given a sheet with the text of the first main task.

In order to write down the condition of the invented problem, the student received a new sheet of paper. To facilitate inventing a plot and in order to describe the relationship of a person with some object, the student was given the cards mentioned above. The student had the opportunity to place and compare these cards in different versions.

When the student was asked to come up with new problems, they did not indicate how many there should be. They just said: "As much as you want, come up with as much."

Observations of the creative actions of students made it possible to distinguish five groups of subjects.

The students of the first group were not able to come up with tasks: "... I don't understand what to do...", "... I can't..." and other similar statements.

The actions of the second group of subjects were formal. This was manifested in the fact that some students reread the first main task given to them as the starting point for the essay, and some did not reread it (it should be noted that the sheet with the condition of this task was located on the left side of the table next to the student).

Observations of the children's actions showed that when reading the original problem (in particular, this was noticeable when reading aloud), the students did not analyze its condition. In other words, they treated the text as if it were some small story, and not as a condition of the problem.

The reading of the original problem was followed by the composition of a new problem, which the children themselves did not try to solve. In other words, they acted formally: they simply came up with some kind of text similar to the original problem. It was possible to observe different variants of such formal production.

The first option was characterized by composing unsolvable problems. For example: “Vera and Katya drank compote: someone from apple, someone from plum. Vera did not drink pear compote. What did Katya drink?” An analysis of such a problem shows that it is impossible to answer her question, since there is not enough information.

The second variant was characterized by composing non-problematic tasks. For example: “Vika and Gena ate fruit: some apples, some pears. Vika ate apples, Gena ate pears. Who ate apples?” It can be seen that the answer is given in the condition of the problem, so there is no actual problem, no problem, nothing to solve.

The actions of the third group of subjects were meaningful. In this case, the students came up with one or two solvable and problematic tasks. At the same time, having composed a problem, they necessarily solved it in order to find out, as they said, "... the problem turned out to be correct or not ...". For example: “Oleg and Vitya solved examples. Someone solved four examples, someone five. Vitya did not solve four examples. How many examples did Oleg solve? Another task: “Misha and Valya drew figures. Someone drew squares, someone triangles. Misha didn't draw triangles. What did Valya draw?”

Observations of the actions of the subjects of this group showed that when composing tasks, they carefully studied the original task (reread its condition several times, broke it into parts, into separate sentences). Thus, it can be assumed that the students tried to analyze the task in this way, to understand how it's built.

The actions of the fourth group of subjects were not only meaningful, but also productive. In this case, the students came up with not one - two solvable, problematic tasks, but three - five similar tasks.

For example, the following three tasks:

(1) “Vera and Katya drank juice: some tomato, some apple. Vera did not drink tomato juice. What did Katya drink?”

(2) “Nadya and Lara bought clothes for the dolls: some pants, some skirts. Nadia didn't buy pants. What did Lara buy?”

(3) “Oleg and Galya drew: some domestic animals, some wild. Oleg did not draw wild animals. What did Galya draw?”

2.2. Second series of experiments

In the second series (as noted), the children first solved the training problem and the three main problems. If the third main task was solved successfully, then it was proposed to produce tasks of the second degree of complexity in a visual-figurative form. The student received the task: "Come up with tasks where three people did something." At the same time, the student was placed on the table a sheet with the text of the second main task. This made it easier for him to produce tasks of the second degree of complexity. In addition, cards with drawings of people, things and various activities were offered.

Observations of the creative actions of students made it possible to distinguish four groups of subjects.

The actions of the first group of subjects were formal. One part of the children offered unsolvable tasks, the other part - non-problem tasks.

The actions of the second group of subjects were meaningful. They managed to come up with one or two solvable and problematic tasks of the second degree of complexity. At the same time, as one could see, before finding the last version of the problem condition, these subjects themselves solved these problems. For example, the following task was invented: “Kostya, Vitya and Misha ate vegetables. Someone ate cucumbers, someone ate tomatoes, someone ate radishes. Kostya ate cucumbers, Vitya did not eat tomatoes. What did Misha eat?”

The actions of the third group of subjects were not only meaningful, but also productive. In this case, the students came up with not one or two solvable and problematic tasks, but three or five similar tasks: in these tasks, the condition was constructed according to one template.

For example, the following five tasks:

(1) “Vika, Nina and Valya sculpted animals: someone - a hare, someone - an elephant, someone - a giraffe. Vika sculpted a hare, Nina did not sculpt an elephant. Who sculpted a giraffe?”

(2) “Dasha, Olya and Sveta ran a hundred meters: someone ran first, someone second, someone third. Dasha came running first. Olya did not come running second. Who came running third?”

(3) Kostya, Misha and Lenya bought cars: someone bought a red car, someone bought a blue car, someone bought a green one. Kostya bought a red car, Misha did not buy a blue car. What car did Lenya buy?”

(4) Katya, Liza and Anya ate porridge: someone ate rice porridge, someone buckwheat, someone pearl barley. Katya ate rice porridge, Liza did not eat buckwheat porridge. What kind of porridge did Anya eat?”

(5) Igor, Vitya and Borya were throwing the ball into a basketball basket: someone hit it twice, someone hit it three times, someone hit it four times. Igor hit twice, Vitya hit three

times. How many times did Borya get into the basket?"

Thus, in the second series there were no subjects who refused or failed to come up with tasks.

2.3. Third series of experiments

In the third series, it was proposed to solve and produce tasks of the first degree of complexity in a verbal-sign form. This means that in this series (unlike in the previous two series), the subjects were not given cards with drawings of various actions of people with various objects to help in creating plots for tasks.

Thus, it was necessary to solve and, most importantly, to come up with problems not in a visual plan, but in an abstract one, in particular, in a speech plan (orally or in writing). Under such conditions, the use of various kinds of drawings and images was excluded. In other words, tasks had to be solved and thought out in an internal, mental plan. At the same time, as in the first series, when composing tasks, the students could rely on the text of the first main task, placed on a separate sheet, which was located on the table to the left of the subject.

As in the first series, each subject must at the beginning of the experiment cope with the training task and three main tasks of varying complexity: with two characters and two objects in the condition, with three characters and three objects, and with four characters and four objects in the condition. In the event that the subject was able to solve the problem of the second degree of complexity (with three characters), then further he had the opportunity to compose tasks of the first degree of complexity (with two characters in the condition).

Observations of the students' creative actions made it possible to single out three groups of subjects, similar to how it was in the previous series. Thus, the first group consisted of subjects who acted formally, composing unsolvable and non-problem tasks. The second group consisted of subjects who acted meaningfully, composing one or two solvable and problematic tasks. The third group consisted of subjects who acted not only meaningfully, as in the students of the previous group, but also, unlike the students of the previous group, productively, composing three to five similar tasks.

2.4. Fourth series of experiments

In the fourth series, tasks of the second degree of complexity were solved and produced in a verbal-sign form. This means that, as in the third series, the subjects were not given cards with drawings of various actions of people with various objects and were required to solve and invent in an internal, mental plan, using oral or written speech.

At the beginning of the experiment in this series, the subjects solved the training problem, and then the main tasks. If the student was able to correctly solve the main task of the third degree of complexity (with four characters and four objects in the condition), then they were able to compose problems with three characters in the condition (tasks of the second degree of complexity). At the same time, as in the second series, when composing problems, the students could rely on the text of the second main problem, placed on a separate sheet, which was located on the table to the left of the subject.

Observations of the students' creative actions made it possible to single out three groups of subjects, similar to how it was in the two previous series. Thus, the first group consisted of subjects who acted formally, composing unsolvable and non-problem tasks. The second group consisted of subjects who acted meaningfully, composing one or two solvable and problematic tasks. The third group consisted of subjects who acted not only meaningfully, as in the students of the previous group, but also, unlike the students of the previous group, productively, composing three to five similar tasks.

3. Results

Among the pupils of the fourth grade, 28 people participated in the first series, 27 in the second, 29 in the third, and 28 in the fourth.

The table 1 shows the number of fourth grade students who produced logical problems in a formal, meaningful and productive way in each of the four series of experiments.

Table. The results of students who acted in formal, meaningful and productive ways (in %)

Ways of composing problems	Series of experiments			
	First	Second	Third	Fourth
Formal	17,9**	22,2**	27,6*	35,8
Meaningful	53,6 **	51,9**	48,3*	46,4
Productive	29,5	25,9	20,7	17,8

*Note: **p<0.01; *p<0.05.*

Analysis of the table data allows us to formulate a number of provisions.

First, the number of children producing unsolvable and non-problem tasks (i.e., children acting in a formal way) increases with each series of experiments. This fact allows us to conclude that the more difficult the conditions for producing tasks, the more children act in a formal way.

Indeed, in the second series, unlike the first series, it was required to compose problems of the second degree of complexity - an increase of 4.3%. In the third series, although it was necessary to compose tasks of the first degree of complexity, this had to be done not in a visual-figurative form, but in more complex conditions: in a verbal-sign form, i.e. in the internal, mental plan without relying on the drawings and images placed on the cards offered to the children. In this case, the increase in the number of schoolchildren was 8.8%, which is significantly more (more than twice) than the increase in the second series in relation to the first.

In the fourth series, where it is required, as in the previous series, to compose problems in a verbal-sign form, the conditions for producing problems become even more complicated, since it is required to compose problems not of the first degree of complexity (where in the conditions there are two characters and two related objects with them), as in the previous series, but tasks of the second degree of complexity (where in the conditions there are three characters and three objects associated with them). In this case, the increase in the number of schoolchildren was 4.8%, which is almost the same as the increase in the second series in relation to the first series.

Characterizing the marked changes in the number of subjects from series to series, we can state the following.

First, the increase in the number of subjects is related to how the conditions for producing tasks in a particular series change the increase in subjects is due to how the conditions for producing tasks in a particular series change. So, if there is a change in the complexity of the produced tasks (from the first series to the second and from the third series to the fourth), then in these cases the increase in the number of subjects is relatively insignificant (respectively: by 4.3% and 4.8%). If there is a change in the form of action in which it is required to produce tasks (from the second series to the third series), then the increase in the number of subjects is relatively significant, 8.8%.

Secondly, the number of children who produced one or two solvable and problematic tasks (i.e., children acting in a meaningful way), in contrast to the subjects who acted in a formal way, decreases with each series of experiments. So, in the second series in relation to the first, the number of subjects decreased slightly, by 1.8%, in the third series, in relation to the second, the decrease was more noticeable - by 3.5%, and in the fourth series, in relation to the third series, the decrease became less significant than in the transition from the second series to the third series, and amounted to - almost, as in the second series in relation to the first series - 1.9%.

Characterizing the noted changes from series to series in the number of subjects who acted when producing tasks in a meaningful way, it can be argued, as in relation to the change from series to series in the number of subjects who acted when producing tasks in a formal way, that a change in the number of subjects acting in a meaningful way, associated with changes in the conditions for the production of tasks.

In particular, the decrease in the number of subjects from the first series to the second and from the third series to the fourth (respectively, a decrease by 1.8% and 1.9%) occurs by a smaller amount than the decrease in the number of subjects from the second series and to the third series, – by 3.5%. This indicates that a change in the form of action when producing tasks (from visual-figurative to verbal-sign) has a greater effect on the success of producing tasks in a meaningful way than changing the complexity of tasks produced (from the first degree to the second degree).

Thirdly, the number of children who produced three to five solved and problematic tasks (i.e. children acting not only in a meaningful way, but also in a productive way) is the same as the number of subjects who acted only in a meaningful way, decreases with each series of experiments. So, in the second series, in relation to the first, the number of subjects decreased by 3.6%, in the third series, in relation to the second, the decrease was 5.2%, in the fourth series, in relation to the third series, the decrease became less significant (than in the third series in relation to the second series), and amounted to 2.9%.

Characterizing the observed changes from series to series in the number of subjects who acted in the production of tasks in a productive way, it can be argued - as in relation to the change from series to series in the number of subjects who acted in the production of tasks in a formal way and in a meaningful way - that the change in the number of subjects who acted in a productive way, are associated with changes in the conditions for producing tasks.

In particular, the decrease in the number of subjects from the first series to the second and from the third series to the fourth (respectively, a decrease by 3.6% and 2.9%) occurs by a smaller amount than the decrease in the number of subjects from the second series and to the third series, – by 5.2%. This indicates that a change in the form of action during the production of tasks (from visual-figurative to verbal-sign) has a greater effect on the success of producing tasks in a productive way than a change in the complexity of the tasks produced (from the first degree to the second degree).

4. Conclusion

The analysis of the data presented in the table allows us to note an important fact: regardless of the method of producing specific logical tasks (formal, meaningful or productive), the success of their production is more associated with a change in the form of action as a condition for production (in particular, from a change in the visual-figurative form to verbal-sign) than with a change in the complexity of the produced tasks (i.e., with a change from the first degree of complexity to the second degree of complexity).

The noted connection is manifested in the fact that a change in the form of action during the production of tasks has a greater effect on the success of production. In particular, the transition from a visual-figurative form to a verbal-sign form complicates the production of tasks to a greater extent than the change in the complexity of the produced tasks from the first degree of complexity to the second degree of complexity.

In general, it can be said, based on the data obtained in the study, that in relation to the production of specific logical tasks, teaching children in the lower grades (this can be judged by the actions of fourth-graders as primary school graduates) is a period of relatively intensive (compared to other methods of production of tasks - formal and productive) the formation of a meaningful way of composing tasks.

In the future, it is planned to conduct a study of the features of the production of concrete-logical tasks with students of other grades of primary school (first, second and third) in order to study the age dynamics of the formal, meaningful and productive ways of producing these tasks.

In the future, it is planned to conduct a study of the features of the production of concrete-logical tasks with students of other grades of primary school (first, second and third) in order to study the age dynamics of the formal, meaningful and productive ways of producing these tasks.

At the same time, it is of serious theoretical and practical interest to conduct research with schoolchildren studying in the middle grades of school: fifth - sixth, seventh – ninth. This will make it possible to more informa-

tively characterize the age-related dynamics of the formation of children's creative actions throughout their education in elementary and secondary schools.

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МЕТОДИКА ПОСТАНОВЛЕНИЯ ЛОГИЧЕСКИХ ЗАДАЧ ЧЕТЫРЕХКЛАССНАЯ ШКОЛА

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Аннотация. *В статье представлено исследование, направленное на изучение особенностей творческих действий четвероклассников при подготовке логических задач. Охарактеризованы основные способы творческой деятельности: формальный, содержательный и продуктивный. Установлено распространение этих методов среди четвероклассников. Исследование показало, что большинство четвероклассников используют содержательный метод при составлении логических задач.*

Ключевые слова: *учащиеся четвертого класса; логическая проблема; методы производства: формальные, содержательные и продуктивные.*