CHARACTERISTICS OF THE PRODUCTION OF LOGICAL PROBLEMS IN PRIMARY SCHOOL

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Abstract. *The article presents a study of the characteristics of producing logical problems by the fourth grade students. There are methods of producing logical problems: formal, substantial and productive. The study of the distribution of these methods among fourth-grade students showed that the majority of children are characterized by the substantial method of producing logical tasks.*

Keywords: *the fourth grade students, logical problem, forms of action: visual-figurative, verbal-sign, methods of producing: formal, substantial and productive.*

The development of problems associated with the creative mental activity of younger students is an important area of psychological and pedagogical research. In the new Federal State Educational Standard, primary education is given the task of assessing the quality of education based on determining the degree of achievement of meta-subject educational results. It is pointed out that one of the essential meta-subject results is the ability to solve problems of a creative nature [1].

It should be noted that a significant number of domestic and foreign studies are devoted to the study of the characteristics of solving creative problems by younger students. The analysis of the content of these studies showed that the creative thinking activity associated with the composition of tasks, in particular, logical ones, has not been sufficiently studied.

The purpose of our work was to study the methods that younger schoolchildren use when solving problems of a creative nature associated with the composition of logical problems.

In a series of individual search experiments, in which fourth grade pupils participated, a technique was used that included logical problems, the content of which reflects a certain life situation. For example: “Misha, Sasha and Nina ran to the distillation. Nina came running earlier than Sasha, and Sasha came running earlier than Misha. Which of the students ran the slowest? "

Problems of this kind (i.e. problems with a plot) can be called concrete-logical problems (for more details about concrete-logical problems, i.e. problems with history, with a plot, – see, for example, our research and research by other authors).

The marked problems differ from problems without a plot (“A is more than B, B is more than C. What is more than all – A, B or C?”), which can be called abstract logical problems.

During the experiment, each child had to first solve a specific logical problem, and then invent, compose, and produce similar problems. The experiments carried out made it possible to characterize three ways of producing specific logical problems.

The first method is associated with the fact that students come up with non-problematic and unsolvable problems. In some cases, they propose such problems, where part of the condition is the desired one (these are non-problematic problems). For example: “Masha, Vera and Olya swam across the river. Vera swam faster than Olya. Masha swam faster than Vera. Who swam faster than Vera? "

In other cases, students offer 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. The mosquito flew faster than a fly. Who flew the fastest? "

The first way of producing tasks can be characterized as formal. In this case, the ac-

tions of the children are only superficially similar to the actions of composing problems: a condition of the problem and a question are proposed, but the problem either does not require a solution or does not have a solution.

The second method is associated with the fact that students offer one or two tasks, approaching production activities meaningfully. This means, firstly, that what is sought should not repeat the condition, and, secondly, that the problem must have a solution.

For example, the first task: “Nikolai, Svetlana and Sergei had animals at home. Some had a cat, some had a hamster, some had a dog. Svetlana did not have a dog. Sergei did not have a dog or a cat. Who had a hamster? " Second task: “Petya, Borya and Alik got to school by different transport. Someone on the bus, someone on the trolleybus, someone on the subway. Borya did not take the bus. Petya did not travel by bus or subway. Who was on the subway? "

The third way is associated with the fact that students also offer tasks to be solved, but not one or two, as in the previous case, but three - five similar tasks. Here, therefore, students approach the production of problems not only meaningfully, but also effectively.

For example, the following three tasks were proposed. The first task: “Borya, Gena and Vasya were shooting from a bow. Borya shot better than Gena. Gena shot better than Vasya. Who was the best shot? " Second task: “Vera, Nina and Vika were eating porridge. Vera ate faster than Nina. Nina ate faster than Vika. Who ate the fastest? " The third task: “Katya, Misha and Sveta were jumping high. Katya jumped higher than Misha. Misha jumped higher than Sveta. Who jumped the highest? "

The specific goal of the present study was to establish how many fourth grade students formally produce tasks, how many students produce tasks using a meaningful way, and how many students produce tasks using an effective way of writing three to five tasks.

Four series of individual experiments were carried out. In the first series, it was necessary to solve problems of the first, second and third degrees of complexity and to produce problems of the first degree of complexity in a visual-figurative form. In the second series, it was also necessary to solve problems of three degrees of complexity, but it was proposed to 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 to produce problems of the first degree of complexity in verbal and symbolic form. In the fourth series, it was also necessary to solve problems of three degrees of complexity, but it was proposed to produce problems of the second degree of complexity in a verbal-symbolic form.

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

A total of 224 fourth-grade students participated in four series of experiments: in the first series – 56 people, in the second – 54, in the third – 58, and in the fourth – 56.

2. Materials and methods

2.1. First series

First series as noted, the meaning of the first series was, according to the experimenter's requirements, first to solve problems of the first and second degrees of complexity, and then to come up with problems of the first degree of complexity. It was necessary to solve and come up with 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 were various drawings of children: boys and girls, in different clothes, at different activities. On the other side of the cards were painted a variety of objects that are widespread in different situations: on city streets, in houses, in schools and other places.

First of all, the student received a sheet of paper on which was the text of the training problem: “Alla and Vera bought writing materials. Someone bought a pen, someone a notebook. Alla bought a notebook. What did Vera buy? " This problem had to be read and the answer found. In case of an incorrect solu-

tion to this problem, the experiment with the student ended.

In the case of the correct solution of this problem, the student was given the main problems: №1, №2, №3. Problem №1 was of the first degree of difficulty, problem №2 – of the second degree, №3 – of the third degree of difficulty. The text of each problem was printed in large print and placed on a separate sheet.

Problem №1: “Sveta and Gena read stories: someone about birds, someone about fish. Sveta did not read about fish. Who did Gena read about? " Since there are only two characters in the condition of this problem, it is possible to draw a conclusion by comparing the particular judgment (the second sentence of the problem) with the general judgment (the first sentence of the problem).

If this problem was solved incorrectly, the experiment with the child was terminated. With the correct solution of this problem, the student was offered problem number 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 clean? "

There are three characters in the condition of this problem. Therefore, the conclusion should be made by means of two comparisons: first, one particular judgment (third sentence of the problem) with the general (second sentence of the problem), then the second particular judgment (fourth sentence of the problem) with the general. This circumstance allows us to qualify this task as a task of the second degree of complexity.

With the correct solution to problem №2, the opportunity was given to solve problem №3: “Sasha, Vika, Nadya and Tanya traveled. Someone went to Orsk, someone to Vorkuta, someone to Tambov, someone to Kirov. Sasha flew to Orsk. Vika flew to Vorkuta. Nadia did not fly to Tambov. Where did Tanya go? "

In the condition of this problem there are four characters and the conclusion can be made by sequentially comparing each of the three particular judgments (the third, fourth and fifth sentences of the problem) with the general one (the second sentence of the problem). This circumstance allows us to qualify this problem as a problem of the third degree of complexity.

If the student solved problem №22 correctly, then he was instructed to come up with problems of the first degree of complexity, where there were two characters: “Try yourself to come up with problems in which two people did something. You have already solved this problem. Compose as many problems as you can." For the composition, the student was given a sheet with the text of the first main problem.

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

When a 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 the pupils made it possible to distinguish five groups of subjects.

Pupils of the first group were unable to come up with problems: "... 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 re-read the first main task given to them as the initial one 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 actions of children showed that when reading the original problem (in particular, it was noticeable when reading it aloud), the students did not analyze its condition. In other words, they treated the text as a little 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. Different variants of such formal production could be observed.

The first option was characterized by the composition of unsolvable problems. For example: “Vera and Katya drank compote: some from apples, some from plums. Vera did not drink pear compote. What was Katya drinking? " Analysis of such a problem shows that it is impossible to answer its question, since there is not enough information.

The second option was characterized by writing non-problematic tasks. For example: “Vika and Gena ate fruit: some apples, some pears. Vika ate apples, Gena ate pears. Who ate the apples? " It can be seen that the answer is given in the condition of the problem, so there is nothing to look for, a solution is not required.

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 must solve it in order to find out, as they said, "... the problem turned out right 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 did not draw triangles. What was Valya drawing? "

Observations of the actions of the subjects of this group showed that, while composing problems, they carefully studied the original problem (they reread its condition several times, broke it into parts, into separate sentences) .Thus, we can assume that the students tried to analyze the problem in this way, to understand how it is built.

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

For example, the following three tasks:

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

(2) “Nadia and Lara bought clothes for the dolls: someone a dress, someone a hat. Nadia didn't buy the dress. What did Lara buy?"

(3) “Oleg and Galya painted: some pets, some wild ones. Oleg did not paint wild animals. What did Galya draw?"

2.2. Second series

In the second series (as already noted), the children first solved the training task, and then the three main tasks. If the third main task was successfully solved, then it was proposed to produce tasks of the second degree of complexity in a visual-figurative form.

The student received an assignment: "Think of tasks where three people did something". At the same time, the student was put 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 were offered with pictures of people, things and various activities.

Observations of the creative actions of students allowed us to distinguish four groups of subjects.

The actions of the first group of subjects were formal. One part of the children suggested unsolvable tasks, the other part – non-problematic 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 can be seen, before finding the last variant of the problem condition, these subjects themselves solved these problems.

For example, the following problem was invented: «Kostya, Vitya and Misha were eating vegetables. Some ate cucumbers, some tomatoes, some 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, effective. In this case, the students came up with not one-two solved and problematic problems, but three - five similar problems: in these problems 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 the giraffe?“

(2) “Dasha, Olya and Sveta ran a hundred meters: someone came running 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 toy cars: someone bought a red car, someone a blue one, someone 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 barley. Katya ate rice porridge, Liza did not eat buckwheat porridge. What kind of porridge did Anya eat?“

(5) Igor, Vitya and Borya threw the ball into the basketball basket: someone hit twice, someone three times, someone four times. Igor hit two times, Vitya missed three times. How many times did Boris get into the basket?“

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

2.3. Third series

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

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

Just as in the first series, at the beginning of the experiment, each subject had to cope with a training task and three main tasks of varying complexity: with two characters and two objects in the condition (task №1), with three characters and three objects (task №2) and with four characters and four objects in the condition (problem №3). In the event that the subject was able to solve a problem of the second degree of difficulty (with three characters), then later he had the opportunity to compose problems of the first degree of difficulty (with two characters in the condition).

Observations of the creative actions of the pupils made it possible to distinguish 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-problematic tasks. The second group consisted of subjects who acted meaningfully, composing one or two tasks to be solved and problematic. 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, effectively, writing three to five similar problems.

2.4. Fourth series

In the fourth series, tasks of the second degree of complexity were solved and produced in a verbal-symbolic 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 had to solve and come up with an inner, mental plan, using oral or written speech.

At the beginning of the experiment in this series, the subjects solved the training problems, and then the main problems. If the student was able to correctly solve the main problem of the third degree of complexity (with four characters and four objects in the condition), then they had the opportunity to compose problems with three characters in the condition (problems of the second degree of difficulty). At the same time, as in the second series, when composing problems, 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 creative actions of the pupils made it possible to distinguish 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-problematic tasks. The second group consisted of subjects who acted substantially, composing one or two tasks to be solved and problematic. The third group consisted of subjects who acted not only substantially, as in the students of the previous group, but also, in contrast to the students of the previous group, effectively, composing three to five similar problems.

3. Results

Among the pupils of the fourth grade, 56 people participated in the first series, 54 in the second, 58 in the third, and 56 in the fourth.

The table shows the results of fourth grade students who produced logic problems in formal, substantial and effective ways in each of the four series of experiments.

Table. The number of fourth-graders who produced problems in formal, substantial and effective ways (in %)

The ways producing problems	Series of experiments			
	First	Second	Third	Fourth
Formal	17,9 **	22,2	31,0	35,8**
Substantial	53,6	51,9	48,3	46,4
Effective	32,1*	27,8	20,7	17,9*

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

Analysis of the data in the table makes it possible to formulate a number of provisions.

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

Indeed, in the second series, in contrast to the first series, it was required to compose problems of the second degree of complexity – the increase was 3.3%. 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-symbolic form, i.e. in the internal, mental plan without reference to the drawings and images placed on the cards offered to children. In this case, the increase in the number of schoolchildren amounted to 8.8%, which is significantly higher 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-symbolic form, the conditions for the production of problems become even more complicated, since it is required to compose problems not of the first degree of complexity (where there are two characters and two related objects with them), as in the previous series, and tasks of the second degree of complexity (where there are three characters and three related objects in the conditions). In this case, the increase in the number of schoolchildren was 4.8%, which is slightly more than the increase in the second series in relation to the first series.

Thus, if there is a change in the complexity of the tasks produced (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 3.3% 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%. And if there is a simultaneous change in the form of action and a change in the complexity of the tasks produced, then the increase in the number of subjects is very significant – 17.8% (in the latter case, the difference between the indicators of 17.9% and 35.7% is statistically significant (at p <0.01).

Second, the number of children who produced one or two solvable and problematic tasks (i.e., children who act 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%.

Thus, 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 of 1.8% and 1.9%) is less than the decrease in the number of subjects from the second series to the third series, – by 3.5%.

Thirdly, the number of children who produced three to five solvable and problematic tasks (i.e., children who act not only in a substantial way, but also in a effective way), as well as the number of subjects who acted only in a substantial way, decreases with each series experiments. So, in the second series in relation to the first, the number of subjects decreased by 4.3%, in the third series in relation to the second, the decrease was – 7.1%, 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 2.8%.

Thus, 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 4.3% and 2.9%) is less than the decrease in the number of subjects from the second series to the third series, – by 7.1%. It is important to note that when there is a simultaneous change in the form of action and a change in the complexity of the tasks produced, the increase in the number of subjects is the most significant – 14.2% (in the latter case, the difference in indicators of 32.1% and 17.9% is statistically significant (with $p < 0.05$).

4. Conclusion

So, this article outlines the content of the study, which involved a total of 224 primary school students (grade 4). The purpose of the study was to study the characteristics of the creative mental activity of children in writing, producing plot-logical problems. It was necessary to determine the peculiarities of the production of problems on the basis of a formal approach, substantial and effective, and to establish the number of students producing problems formally, substantially and effectively. Four series of experiments were carried out, where children were asked to produce problems of varying complexity in visual-figurative and verbal-symbolic forms.

As a result of the study, for the first time, conditions were established that affect the success of the production of problems under the conditions of a formal, meaningful and effective approach. It was shown that regardless of the approach applied by the students, the success of the production of problems is associated both with the complication of the problems produced and with a change in the form of action in which it is proposed to compose problems. At the same time, it was determined that when composing problems, changing the form of action (from visual-figurative to verbal-sign) reduces the success of production to a greater extent than changing the complexity of the problems being composed (from the first degree of complexity to the second).

In addition, summarizing the results of the experiments, there is reason to assert that they indicate that most of the children use a meaningful way to compose problems, and a smaller part use a formal and effective way.

In general, the study made it possible to obtain new facts characterizing the creative thinking activity of younger schoolchildren (in particular, fourth grade students). Knowledge of these facts seriously expands the concept of developmental psychology about the peculiarities of thinking in primary school children in general and about the characteristics of their creative thinking in particular.

In the future, it is planned to conduct a study of creative mental activity related to the composition of plot-logical problems on the contingent of primary schoolchildren studying in the first, second and third grades of primary school.

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ХАРАКТЕРИСТИКИ ПРОДУЦИРОВАНИЯ ЛОГИЧЕСКИХ ЗАДАЧ В НАЧАЛЬНОЙ ШКОЛЕ

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Аннотация. *В статье представлено исследование характеристик продуцирования логических задач учениками четвертого класса. Выделены способы продуцирования логических задач: формальный, содержательный и продуктивный. Изучение распределения этих способов среди учеников четвертого класса показало, что для большинства детей характерным выступает содержательный способ продуцирования логических задач.*

Ключевые слова: *четвероклассники, логические задачи, формы действия: наглядно-образная, словесно-знаковая, способы продуцирования: формальный, содержательный, продуктивный.*