KAPITEL 1 / *CHAPTER 1*[1]
FEATURES OF THE FORMATION OF META-SUBJECT COMPETENCIES OF SECONDARY SCHOOL STUDENTS

ОСОБЕННОСТИ ФОРМИРОВАНИЯ МЕТАПРЕДМЕТНЫХ КОМПЕТЕНЦИЙ УЧАЩИХСЯ СРЕДНЕЙ ШКОЛЫ

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Introduction

The general meaning of this study was to develop such an important direction in solving the fundamental psychological and pedagogical problem "Training and Development" as establishing the characteristics of the formation of meta-subject cognitive competencies in schoolchildren during the period of study in the fifth, sixth and seventh grades of basic school.

According to the provisions of the new Federal State Educational Standard of Basic General Education [5], mastering by children of the basic educational program of the fifth-seventh grades of the basic school should lead not only to the achievement of subject educational results based on the assimilation of the content of programs of specific academic disciplines, but also to the formation of meta-subject cognitive competencies associated with mastering schoolchildren with the ability to build logical reasoning, inference and draw conclusions; with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; with the mastery of schoolchildren's ability to independently plan ways to achieve the goal; with the development by them of the initial forms of cognitive reflection and the skills associated with it to exercise control over their actions, to determine and correct their methods.

In understanding the effectiveness of ways to solve problems of a search nature, in interpreting the forms of cognitive reflection and the ability to determine and correct methods for solving problems, in interpreting the characteristics of the formation of skills to independently plan ways to achieve a goal, and in assessing the ability to build logical reasoning, inference and draw conclusions, we relied on the provisions of two types of cognitive activity developed in dialectical logic and implemented in the studies of V.V. Davydov [2] and in the works of his followers (see, for example, [1, 3,]).

According to these provisions, a person who cognizes the surrounding reality can be aimed both at reflecting the internal connections and relations of objects and phenomena, thereby realizing theoretical, meaningful, reasonable knowledge, and at reflecting their external connections and relations, thus realizing way, empirical, formal, rational knowledge. The first case is characterized by the effectiveness of cognitive activity, because its result is associated with the identification of the causes underlying the changes in the object being cognized, which is the basis for the development of the corresponding pattern. The second case is characterized by insufficient efficiency of cognitive activity, because its result is associated only with the description and classification of externally presented characteristics of changes in

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objects of knowledge. In this case, it is impossible to reveal the reasons for the change in the object being known and to reliably characterize the patterns of its existence in the past, present and future.

Based on the above provisions on the content and methods of different types of cognition, an understanding of the features of the types of cognitive meta-subject competencies was developed [4]. In accordance with this understanding, the development of methods for solving problems in one case is associated with the allocation of significant data relationships contained in their conditions, in the other case, the disclosure of significant data relationships that are objectively contained in the conditions of the problems being solved does not occur. The development of a solution method associated with the allocation of significant relations is implemented as a meaningful action, the result of which is a general method of solving problems, and the development of a solution method not associated with the allocation of essential relations is implemented as a formal action, the result of which is a particular method of solving problems.

In accordance with the above provisions on the two types of cognitive activity, it was also accepted that cognitive reflection and the skills associated with it to determine and correct methods of action in solving problems can be associated with a person's appeal in one case to the foundations of these methods and with understanding the features of their development as related with significant relationships under the conditions of the proposed tasks. In another case, cognitive reflection and the skills related to it to determine and correct methods of action in solving problems can be associated with a person's appeal only to the external features of these methods without comprehending their objectively existing connections with significant relationships in the conditions of the problems being solved. In the first case, cognitive reflection is realized as a meaningful action, and in the second case, as a formal action.

When analyzing the features of planning, two approaches were considered in developing a program of action in a situation of problem solving. Within the framework of one approach, the solution of search problems includes two stages - research and execution. At the first stage, the conditions of the proposed problem are analyzed, associated with the identification of data and their relationships in the conditions and the preparation of a plan for solving the problem.

The content of planning at this stage is the determination of the sequence of all actions required for a successful solution of the problem, the development of a program for the implementation of previous and subsequent actions to solve the problem in the entire volume. It is important to emphasize that all the required actions in this case are outlined before the implementation of the solution to the proposed problem.

Within the framework of another approach, the research stage associated with the analysis of the conditions of the proposed problem and the planning of its solution as a whole is absent. Drawing up a plan in this approach is carried out in parts, each of which may include one or more required actions. In this case, subsequent actions are scheduled only after the previous ones have been completed.

Planning, implemented on the basis of the first approach, is carried out as a

meaningful action, since the action program for solving the problem is developed based on the analysis of the entire amount of data contained in the condition of the proposed problem. Planning, implemented on the basis of the second approach, is carried out as a formal action, since the program of actions to solve the problem is developed and implemented in parts, in separate links, without comprehending the content of previous and subsequent actions and their relationships within the entire set of actions to solve the proposed problem.

When developing criteria and indicators of the formation of skills in building logical reasoning and inference, the fact was taken as a basis that in one case, deriving a conclusion from the proposed judgments is based on highlighting their true relationships, and in the other case, deriving a conclusion from the proposed judgments is based on highlighting their false ones. relations. Highlighting the true relations of the proposed judgments creates favorable conditions for demonstrating a consistently realized inference, and highlighting the false relations of judgments creates conditions for the emergence of contradictions in the execution of the inference. In the first case, the construction of reasoning is implemented as a meaningful action, in the second case, as a formal action.

The purpose of this study was to determine the characteristics of the formation of cognitive meta-subject competencies of students in the fifth - seventh grades of the basic school.

The study was based on the assumption that cognitive meta-subject competencies associated with schoolchildren's mastery of the ability to build logical reasoning, inference and draw conclusions; with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; with the mastery of schoolchildren's ability to independently plan ways to achieve the goal; with the development of the initial forms of cognitive reflection and the skills associated with it to control their actions, determine and correct their methods, are formed in schoolchildren during the specified period of study with different intensities: the most intensively is the ability to build logical reasoning, less intensively is the ability to implement effective methods solving problems of a search nature, even less intensively - the ability to carry out cognitive reflection and control of one's actions, least intensively - the ability to plan the achievement of a goal.

Material and methods

1.1. The diagnostic of metasubject competences

The diagnostic group lesson on the material of the method "Reasoning" was carried out as follows.

First, the class organizer distributes Answer Sheets to the children, on which they indicate their last name and first name in the nominative case (“Who did the work?”), School number and class name.

ANSWER SHEET

Choose the correct answer and mark as ☑

TASK 1

1. ☐ in a jacket ☐ in a coat ☐ in a raincoat
2. ☐ blue ☐ red ☐ orange
3. ☐ May 2 ☐ May 4 ☐ May 7 ☐ May 8
4. ☐ Yura ☐ Vitya ☐ Vasya ☐ Borya

TASK 2

5. ☐ swimming, ☐ boxing, ☐ wrestling, ☐ jumping
6. ☐ flute ☐ violin ☐ guitar ☐ trumpet
7. ☐ about birds ☐ about fish ☐ about minerals ☐ about plants

Choose and mark the opinion of the student about the tasks that you consider the most correct:

☐ Tanya ☐ Kolya ☐ Vika ☐ Katya ☐ Nina

TASK 3

8. ☐ YLYV ☐ IVLY ☐ IVYL ☐ YLVY
9. ☐ AZNOK ☐ AZOKN ☐ AKNOZ ☐ ANKOZ
10. ☐ ESODIK ☐ ESOKID ☐ EKSODI ☐ DSEOIK
11. ☐ ATARINCS ☐ SARTNCIA ☐ TSARINAC ☐ CARTNISA

TASK 4

12. thinnest: ☐ felt-tip pen ☐ pencil ☐ pen ☐ brush

    shortest: ☐ pencil ☐ pen ☐ brush ☐ felt-tip pen
13. ☐ in the middle ☐ with the edge ☐ in front ☐ behind
14. ☐ Gena ☐ Borya ☐ Sasha ☐ Vova
15. Runs the slowest of all: ☐ Yura ☐ Olya ☐ Misha ☐ Anya

    Jumps the lowest: ☐ Olya ☐ Anya ☐ Misha ☐ Yura

    Dives worst of all: ☐ Misha ☐ Yura ☐ Anya ☐ Olya

After that, sheets with the conditions of the tasks of four tasks are distributed.

TASK 1

1. Two girls were in jackets, and one was in a coat. What was Nadia wearing if Masha and Katya and Katya and Nadia were dressed differently?

2. Two girls embroidered: one with red threads, the other with blue ones. What threads did Natasha have if Olga did not embroider with blue threads?

3. Four days in May there was different weather: 2, 4, 7 and 8. On one day it was cold and rainy, on the other it was warm and dry, on the third it was warm and rainy, on May 4 it snowed. On May 2 and 7 it was warm, on May 2 and 8 it was rainy. Which day was dry and warm?

4. Yura is stronger than Viti. Borya is weaker than Yura. Yura is weaker than Vasya. Who is the strongest?

TASK 2

5. Two boys were engaged in boxing, one in wrestling. What did Yura do if Kolya and Yura, Kolya and Sasha went in for different sports?

6. Three girls studied music: one played the violin, one the guitar, one the flute. What did Natasha play if Marina and Galya played different instruments: the guitar and the flute?

7. Three girls collected stamps: two about minerals and one about birds. What stamps did Anya collect if Ira and Anya, Ira and Olya had different brands?

Task opinions

Several grade 4 students solved these problems and exchanged opinions.
Tanya said: "Problems 5, 6 and 7 are similar."
Kolya disagreed: "Problems 5, 6 and 7 are different."
Vika: “I think that tasks 5 and 6 are similar, but task 7 is different from them.”
Katya: “I think that tasks 5 and 7 are similar, but task 6 is different.”
Nina: “I’m sure that tasks 6 and 7 are similar, but task 5 is different from them.”
Which student is right?

TASK 3

8. In the word "KOGA" the letters were rearranged and the word "OKAG" was obtained. The same permutation was made in the word "VILY". What happened?

9. In the word "PORKA" the letters were rearranged and the word "OPKRA" was obtained. The same a permutation was made in the word "ZAKON". What happened?

10. In the word "MALINA" the letters were rearranged and the word

"AMILAN" was obtained. The same permutation was made in the word "SEDOKI". What happened?

11. In the word "KARANDASH" the letters were rearranged and the word "AKARDNSHA" was obtained. The same permutation was made in the word "STRANICA". What happened?

TASK 4

12. A pencil is thicker than a pen and longer than a marker. A pencil is thinner than a felt-tip pen and shorter than a pen. Which object is the thinnest of all and which is the shortest of all?

13. Yura and Olya Elova, Yura and Olya Azov were sitting on a bench. Both Yuras were nearby and both Azovs were nearby. Where was (in the middle or on the edge) Olya Elova?

14. The guys left at the same time: Borya from Tula to Kiev, Sasha from Kiev to Ruza, Gena from Ruza to Tula. After 2 days it turned out that Sasha is closer to Kiev than Borya is to Tula, and Gena is further from Ruza than Borya is from Tula. Who walked the slowest?

15. Misha runs faster than Olya, jumps higher than Anya and dives better than Yura. Misha jumps lower than Olya, dives worse than Anya and runs slower than Yura. Who runs slowly better than everyone who jumps below everyone, who dives worst of all?

* * * *

Further, the organizer of the lesson explains: “Look at the task sheet. In the first task, you need to solve four problems - the first, second, third and fourth.

In the second task, you need to solve three problems - the fifth, sixth and seventh. And after that, you need to read the opinions of the students about these three tasks, and then on the answer sheet, you must select and mark the name of the student whose opinion you consider the most correct.

In the third task, you need to solve four problems - the eighth, ninth, tenth and eleventh.

In the fourth task, you also need to solve four problems - the twelfth, thirteenth, fourteenth and fifteenth.

After that, the organizer characterizes the content of the answer sheet: “Look at the answer sheet. In problems 1 and 2, you need to choose and mark the correct answer from the three proposed ones, and in problems 3 and 4, you need to select and mark the correct answer from the four proposed ones.

In problems 5, 6 and 7, you need to choose and mark the correct answer from the four proposed. After that, you need to choose and mark the name of the student whose opinion on the tasks each of you considers the most correct.

In problems 8, 9, 10 and 11, you need to choose one correct answer from the four offered.

In problem 12, you must first choose which object is the thinnest, and then which object is the shortest.

In problems 13 and 14, you need to choose the correct answer from the four proposed.

In problem 15, you need to choose first the one who runs the slowest of all, then the one who jumps the lowest, and then the one who dives the worst."

Then the children are told: "For the correct solution of any problem, you need to first, read it several times silently ("to yourself") so as not to disturb the neighbors, then you need to think (also silently) and then, when the solution is clear, you need to choose and mark the answer that you got.

Solve problems only mentally, "in the mind", you can't write something down or make any notes.

Act carefully and independently".

In the Reasoning method, each of the four tasks has a special meaning.

Task 1 is intended to determine the formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning when solving problems in a verbal-sign form. Children are offered four tasks composed of judgments of different types: in the first and third tasks, affirmative attributive judgments are used, in the second task, negative attributive judgments, and in the fourth task, asymmetric relational judgments.

To determine the degree of formation of this cognitive meta-subject competence, one should proceed from the following provisions.

If all tasks are solved incorrectly, then there is a manifestation of the zero level of formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning.

If any one problem is solved correctly, then there is a manifestation of the first level of formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning.

If any two problems are correctly solved, then there is a manifestation of the second level of formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning.

If any three problems are correctly solved, then there is a manifestation of the third level of formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning.

If all four problems are correctly solved, then there is a manifestation of the fourth level of formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning.

It should be noted that the last level characterizes the formation of a meaningful approach to the construction of reasoning, and the first, second and third levels characterize, respectively, the first, second and third degree of formation of a formal approach to the construction of reasoning.

The zero level of formation of the cognitive meta-subject competence associated with the logoic actions of constructing reasoning and inference indicates the absence of both a formal and, moreover, a meaningful approach to constructing reasoning.

Task 2 is intended to determine the formation of cognitive meta-subject competence associated with the implementation of cognitive reflection (in particular,

with the implementation of its initial forms) when solving problems in a verbal-sign form.

The children had to solve three problems: two of them, problems five and seven, were built on the basis of one principle, and one problem, the sixth, was built on the basis of another principle. After solving the marked three problems, it was required to choose one opinion about them from the five proposed. A meaningful generalization of the method of action in solving the fifth and seventh problems, as a manifestation of the implementation of meaningful, internal reflection, is reflected in the choice of Katya's opinion ("…problems 5 and 7 are similar, but problem 6 differs from them…").

Such a choice testifies to the child's knowledge of the grounds for his actions, in particular, to the fact that these two problems are constructed in the same way and are solved on the basis of a single principle for these problems. If the child knows only the external signs of his actions or the external features of the conditions of the problems s, then he chooses any opinion except the fourth.

If, after solving three problems correctly, the child chooses the first, second, third, or fifth opinion (that is, the opinion of Tanya, Kolya, Vika, or Nina, respectively), then in this case it is assumed that formal, external reflection took place during the solution. Therefore, we can conclude that the cognitive meta-subject competence associated with the implementation of cognitive reflection is relatively underdeveloped.

If, having correctly solved three problems, the child chooses the fourth opinion (i.e., Katya's opinion), then in this case it is assumed that meaningful, internal reflection took place during the solution. This fact gives grounds to draw a conclusion about the relatively sufficient formation of cognitive meta-subject competence associated with the implementation of cognitive reflection.

In the absence of a correct solution, either one of these main problems, or two of them, or all three, the choice of the fourth opinion does not indicate the manifestation of formal, or, even more so, meaningful reflection. Such a fact should be qualified as a manifestation of the lack of implementation of reflection.

Task 3 is intended to determine the formation of cognitive meta-subject competence associated with the construction of a method for solving problems of a search nature when solving problems in a verbal-sign form. The children had to solve four problems built on a single principle.

If the child has solved all four tasks correctly, then in this case it is assumed that the decision is based on the identification of essential relationships that underlie the single principle of solution. This means that the solution was carried out in a general way. Therefore, we can conclude that the cognitive meta-subject competence is relatively well-formed and is associated with the construction of a method for solving problems of an exploratory nature. At the same time, a meaningful analysis of the conditions of the problems took place.

If the child did not solve all four problems correctly, but successfully coped with any three, two or one of the four problems, then in this case it is assumed that the decision is not based on the identification of significant relationships that underlie a single principle of solution. This means that the decision was carried out in a partial

way. Therefore, we can conclude that the cognitive metasubject competence associated with the construction of a method for solving problems of a search nature is relatively unformed. At the same time, a formal analysis of their conditions took place.

If the child did not correctly solve any of the four problems, then in this case it is considered that there was no construction of a method for solving problems.

Task 4 is intended to determine the formation of cognitive meta-subject competence associated with the planning of solving problems in a verbal-sign form, which reflects the development of the ability to act "in the mind".

As part of this task, the children were asked to solve four problems that did not have an internal meaningful unity and a common way of solving. When solving each of the following problem out of four, it was required to mentally operate with a gradually increasing number of judgments, from problem to problem, and, thereby, perform more complex reasoning than in the previous problems of this task.

If all problems are solved incorrectly, then there is a manifestation of the zero level of formation of cognitive metasubject competence associated with planning the solution of problems in a verbal-sign form.

If any one problem is solved correctly, then there is a manifestation of the first level of formation of cognitive meta-subject competence associated with planning the solution of problems in a verbal-sign form.

If any two problems are correctly solved, then there is a manifestation of the second level of formation of cognitive meta-subject competence associated with planning the solution of problems in a verbal-sign form.

If any three problems are correctly solved, then there is a manifestation of the third level of formation of cognitive meta-subject competence associated with planning the solution of problems in a verbal-sign form.

If all four problems are correctly solved, then there is a manifestation of the fourth level of formation of cognitive meta-subject competence associated with planning the solution of problems in a verbal-sign form.

It should be noted that the last level of formation of cognitive meta-subject competence characterizes the implementation of a holistic, meaningful planning, when, as can be observed in individual experiments, the reasoning associated with the correlation of the proposed judgments and the comparison of intermediate conclusions is carried out in full in the mental plan, without intermediate objectification in the form of any records or notes.

The first, second and third levels of formation of the considered cognitive meta-subject competence characterize the implementation of partial planning of varying degrees of formation. In this case, as could be observed in individual experiments, multiple labels characterized the performance of more or less of the reasoning.

Children who successfully solved only one problem out of four were distinguished by a large number of notes, those who successfully solved two problems made fewer notes, and children who successfully solved three tasks were characterized by the smallest number of notes. The zero level of formation of this cognitive metasubject competence, when (as could be observed in individual experiments) the child cannot complete the reasoning to the required extent even with

numerous notes, indicates a chaotic correlation of the judgments proposed in the condition of the problem, since the child does not have any control over his actions to solve the problem.

1.2. The results of the diagnostic of logical actions of constructing reasoning

Three series of group experiments were carried out on the material of the method "Reasoning". 198 fifth grade students participated in the first series, 151 sixth grade students participated in the second series, and 124 seventh grade students participated in the third series.

The results of the first task, designed to determine the formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning when solving problems in a verbal-sign form, are presented in Table 1.

Table 1 - Distribution of children among pupils of the fifth, sixth and seventh grades, who showed the zero, first, second, third and fourth levels of formation of the competence associated with the logical actions of constructing reasoning during the first task, (in %).

Classes	Competence levels				
	Forth	Third	Second	First	Zero
5 (198 st.)		27,2	19,2	9,0	5,1
6 (151 st.)		29,1	9,3	4,7	1,3
7 (124 st.)	65,3	21,0	8.1	5,6	0,0

Note: ** - $p < 0,01$.

The data given in the table testify to a number of important characteristics of the formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning during the period of schoolchildren's education in the fifth, sixth and seventh grades of the basic school.

Firstly, in the fifth grade, the group of children with the fourth level of formation of the considered competence is the most numerous - it makes up 39.4% of the entire contingent of children of this age participating in the study, which is 10.6% less than half of this contingent. It is also important to note that the total number of three groups with significantly lower levels of formation of this competence (i.e. with the second, first and zero) is 33.3%, which exceeds the number of children with the third level (27.2%) and only 6.1% less than the number of children with the fourth level of formation of this competence (5.1%).

Secondly, in the sixth grade, in contrast to the fifth, the number of children with the fourth level of formation of this competence is, although insignificant, but the majority (55.6%) of the contingent of this age participating in the study. At the same

time, also unlike the fifth grade, the total number of three groups with lower levels of formation of this competence (i.e. with the second, first and zero) is 15.3%, which is approximately equal to half of the number of children with the third level of formation this competence (29.1%).

Thirdly, in the seventh grade, in contrast to the sixth grade and, moreover, from the fifth grade, the size of the group of children with the fourth level of formation of this competence is already a significant majority, almost two-thirds, of the contingent of this age participating in the study, - 65.3%. At the same time, unlike the sixth and fifth grades, there are no children in the seventh grade who have shown a zero level of formation of this competence.

Describing the formation of competence associated with the logical actions of constructing reasoning during the period of teaching schoolchildren in the fifth, sixth and seventh grades in general, it should be noted that the largest increase in the total number of children with the fourth and third levels of formation of this competence occurs in the sixth grade in relation to the fifth, – by 18.1%, – from 66.6% in the fifth grade to 84.7% in the sixth grade (the difference between these results is statistically significant at $p < 0.01$, – hereinafter, the φ*Fisher test was used to determine the significance of differences). Compared to the noted fact, the increase in the total number of children with the fourth and third levels of this competence in the seventh grade in relation to the sixth grade is insignificant - 1.6% (86.3% in the seventh grade and 84.7% in the sixth grade) .

Concluding the consideration of the features of the formation of cognitive meta-subject competence associated with the logical actions of constructing reasoning among schoolchildren during the period of study in the fifth, sixth and seventh grades, it should be noted a statically significant difference (at $p < 0.001$) in the number of children with the fourth level in the seventh grade in relation to the fifth class (65.3% and 39.4%).

1.3. The results of the diagnostic of the implementation of cognitive reflection

The results of the second task, designed to determine the formation of cognitive meta-subject competence associated with the implementation of cognitive reflection, are presented in Table 2.

The data given in the table testify to the following important characteristics of the formation of cognitive meta-subject competence associated with the implementation of cognitive reflection during the period of schoolchildren's education in grades 5-7 of the basic school.

Firstly, in the fifth grade, the number of children who did not have reflection when solving tasks of task 2 - 47.0% - is almost half of the contingent of this age that participated in the study. At the same time, the number of children who did not have reflection when solving tasks of task 2 exceeds the number of children in each of the other two groups (with internal reflection, 21.2%, and with external reflection, 31.8%). It is also important to note that the number of children with external reflection exceeds the number of children with internal reflection.

Table 2 - Distribution among pupils of the 5th, 6th and 7th grades of children who completed internal cognitive reflection in solving tasks of the second task and completed external cognitive reflection, and children who did not perform reflection at all (in %)

Classes	Internal reflection	External reflection	Absence reflection
5 (198 st.)	21,2**	31,8	47,0
6 (151 st.)	34,4	22,5	43,1
7 (124 st.)	40,3**	20,2	39.5

Note: ** - *p <0,01.*

Secondly, in the sixth grade, in contrast to the fifth grade, the number of children with internal reflection (34.4%) exceeds the number of children with external reflection (22.5%). At the same time, it should be noted that, just as in the fifth grade, the number of children with internal reflection is inferior to the number of children who did not have reflection when solving problems, respectively, 34.4% and 43.1%.

Thirdly, in the seventh grade, as in the sixth and fifth grades, the number of children with internal reflection (40.3%) exceeds the number of children with external reflection (20.2%). However, here it should be noted that, unlike the sixth and fifth grades, the number of children with internal reflection (albeit slightly, by only 0.8%) exceeds the number of children who lacked reflection when solving problems, respectively. , 40.3% and 39.%.

Characterizing the formation of competence associated with different types of cognitive reflection during the period of schoolchildren's education in the fifth, sixth and seventh grades in general, it should be noted that the largest increase in the number of children with internal reflection occurs in the sixth grade in relation to the fifth grade, by 13, 2%: from 21.2% in the fifth grade to 34.4% in the sixth grade (the difference between these results is statistically significant at $p < 0.05$).

At the same time, it is important to note that in general, during the period of study in the fifth, sixth and seventh grades, the number of children with internal reflection increased by 19.1%, from 21.2% in the fifth grade to 40.3% in the seventh grade (the difference between the indicated results are statistically significant at $p < 0.01$).

1.4. The results of the diagnostic of the construction and implementation of problem solving methods

The results of the third task, designed to determine the formation of cognitive meta-subject competence associated with the construction and implementation of problem solving methods, are presented in Table 3.

Table 3 - Distribution among students of grades 5, 6 and 7 of children who solved problems in a general way and solved problems in a private way, and children who did not solve a single problem (in %).

Classes Классы	General way	Partial way	Absent solution
5 (198 st.)	57,5***	39,4***	3,1
6 (151 st.)	64,9	32,5	2,6
7 (124 st.)	79,0***	19,4***	1.6

Note: *** - $p < 0,001$.

The data given in the table testify to a number of important characteristics of the formation of cognitive meta-subject competence associated with the construction and implementation of a method for solving problems during the period of schoolchildren's education in grades 5-7 of basic school.

First, we should note the change in the class-wise ratio of the number of children who solved problems in a general way and solved problems in a particular way. Thus, in the fifth grade, the number of children who solved problems in a private way (39.4%) is 68.5% of the number of children who solved problems in a general way (57.5%).

In the sixth grade, the ratio of the numbers of these groups of children (compared to the fifth grade) decreases and amounts to 50.1%. This is due to the fact that the number of children who solved problems in a private way decreases (in relation to the fifth grade), from 39.4% to 32.5%, and the number of those who solve problems in a general way increases, from 57.5% up to 64.9%.

In the seventh grade (in relation to the sixth grade and, even more so, in relation to the fifth grade), the considered ratio of numbers decreases again and amounts to 24.6%, since (as in the previous case) the number of children who solved problems in a private way decreases (in relation to the sixth grade), from 32.5% to 19.4%, and the number of those who solved problems in a general way increases (in relation to the sixth grade), from 64.9% to 79.0%.

Secondly, the differences in the increase in the number of children who solved problems in a general way, and in the decrease in the number of children who solved problems in a particular way, should be especially noted when considering the transition from the fifth grade to the sixth grade and from the sixth grade to the seventh grade. Thus, from the fifth grade to the sixth grade, the increase in the number of children who solved problems in a general way is 7.4%, from 57.5% in the fifth grade to 64.9% in the sixth grade. At the same time, the decrease in the number of children who solved problems in a private way is 6.9%, from 39.4% in the fifth grade to 32.5% in the sixth grade.

In contrast to the nature of the above changes, the increase in the number of children who solved problems in a general way from the sixth grade to the seventh grade is 14.1%, from 64.9% in the sixth grade to 79.0% in the seventh grade (the difference between these indicators is statistically significant at $p < 0.01$). At the

same time, the decrease in the number of children who solved problems in a private way is 13.1%, from 32.5% in the sixth grade to 19.4% in the seventh grade (the difference between these results is statistically significant at $p < 0.05$).

Describing the formation of this competence associated with the construction and implementation of a method for solving problems during the period of schoolchildren's education in the fifth, sixth and seventh grades, it should be noted, as can be seen from the analysis presented above, that the largest increase in the number of children who solved problems in a general way occurs in seventh grade versus sixth grade.

In general, from the fifth grade to the seventh grade, the increase in the number of children who solved problems in a general way is 21.5% (from 57.5% in the fifth grade to 79.0% in the seventh grade, the difference between these indicators is statistically significant at $p < 0.001$) and, accordingly, the decrease in the number of children who solved problems in a private way is 20.0%, from 3.4% in the fifth grade to 19.4% in the seventh grade, the difference between these indicators is statistically significant (at $p < 0.001$).

1.5. The results of the diagnostic of the independent planning

The results of the fourth task, designed to determine the formation of cognitive meta-subject competence associated with independent planning of the path to achieve the goal, are presented in Table 4.

Table 4 - Distribution of children among pupils of the 5th, 6th and 7th grades, who showed the zero, first, second, third and fourth levels of the formation of competence related to independent planning of the way to achieve the goal when performing the fourth task (in %).

Classes	Competence levels				
	Fourth	Third	Second	First	Zero
5 (198 st.)	9,1	31,3	36,9	15,6	7,1
6 (151 st.)	14,5	24,5**	26,5	29,1*	5,3
7 (124 st.)	17,7	45,2**	21.0	16,1*	0,0

Note: ** - *p <0,01;* * - *p <0,05.*

The data given in the table testify to the following characteristics of the formation of cognitive meta-subject competence associated with independent planning of the path to achieve the goal during the period of schoolchildren's education in grades 5-7 of the basic school.

Firstly, in the fifth grade the number of children with the fourth level of formation of the considered competence is less than the number of children with the

third level of formation of the considered competence, respectively, 9.1% and 31.3%. In addition, the number of children with the fourth level is less than the number of children with the second level, 9.1% and 36.9%, respectively, and less than the number of children with the first level, 9.1% and 15.6%, respectively. At the same time, it should be noted that at the same time the number of children with the fourth level of formation of the considered competence is greater than the number of children with the zero level, respectively, 9.1% and 7.1%,

Secondly, in the sixth grade, as well as in the fifth, the number of children with the fourth level of formation of the considered competence is less than the number of children with the third level of formation of the considered competence, respectively, 14.5% and 24.5%. In addition, the number of children with the fourth level of formation of the considered competence is less than the number of children with the second level, 14.5% and 26.5%, respectively, and less than the number of children with the first level, 14.5% and 29, respectively. At the same time, as in the fifth grade, the number of children with the fourth level of formation of the considered competence is greater than the number of children with the zero level, respectively, 14.5% and 5.3%.

Thirdly, in the seventh grade, as well as in the previous two grades, the number of children with the fourth level of formation of the considered competence is less than the number of children with the third level of formation of the considered competence, respectively, 17.7% and 45.2% . In addition, the number of children with the fourth level of formation of the considered competence is less than the number of children with the second level, respectively, 17.7% and 21.0%. However, in contrast to what was observed in the ratio of the sizes of the discussed groups of children in the fifth and in the sixth grade, in this class the number of children with the fourth level of formation of the considered competence is greater than the number of children with the first level, respectively, 17.7% and 16.1%.

Considering the peculiarities of changes in the number of each of the five groups of children with different levels of competence development related to independent planning of the way to achieve the goal, the following should be noted. Thus, the number of three groups of children - with the fourth level of formation of this competence, with the second level and with the zero level - changes from the fifth grade to the seventh grade sequentially: either it constantly increases - this refers to the number of children with the fourth level (9.1 % in the fifth grade, 14.5% in the sixth grade, 17.7% in the seventh grade) or is constantly decreasing - this refers to the number of children with the second level (36.9% in the fifth grade, 26.5% in the sixth grade). grade, 21.0% in the seventh grade) and to the number of children with a zero level (7.1% in the fifth grade, 5.3% in the sixth grade and 0.0% in the seventh grade).

At the same time, it is important to note that the number of other two groups of children - with the third level of formation of the competence in question and with the first level of this competence, changes inconsistently. This means that the number of children either first decreases and then increases - this refers to changes in the number of children with the third level (31.3% in the fifth grade, 24.5% in the sixth grade, 45.2% in the seventh grade, - the difference between the last two indicators is statistically significant at $p < 0.01$), or the number of children first increases and then

decreases - this refers to the number of children with the first level (15.6% in the fifth grade, 29.1% in the sixth grade, 45, 2% in the seventh grade, the difference between the last two indicators is statistically significant at $p < 0.05$).

Comparing the number of children with different levels of development of the competence associated with independent planning of the way to achieve the goal, it should be noted an increase in the proportion of children with the third level of formation of this competence from the fifth grade to the seventh. So, if in the fifth grade the number of children with the third level was less than the number of children with the second level, respectively, 31.3% and 36.9%, but more than the number of children with the first level, respectively, 31.3% and 15.6% , then in the sixth grade the proportion of children with the third level decreases, both in relation to the number of children with the second level, respectively, 24.5% and 26.5%, and in relation to the number of children with the first level, respectively, 24.5 % and 29.1%. In the seventh grade, the proportion of children with the third level becomes the largest (compared to the number of children in each of the other four groups) and amounts to 45.2%, i.e. almost half of the entire contingent of seventh graders participating in the study.

It can be assumed, therefore, that teaching children at school from the fifth to the seventh grade is the period of mastering the third level of the formation of cognitive meta-subject competence associated with independent planning of the path to achieve the goal. Probably, the majority of children will have to master the fourth level of formation of this competence in the next years of study in an incomplete basic school - the eighth and ninth grades.

So, at the previous stage of the analytical part of the study, the data obtained in experiments were considered, characterizing the features of different levels of formation in schoolchildren - students in the fifth grade, sixth grade and seventh grade of the basic school - cognitive meta-subject competencies associated with the mastery of schoolchildren's ability to build logical reasoning. , inference and draw conclusions; with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; with the mastery of schoolchildren's ability to independently plan ways to achieve the goal; with the development by them of the initial forms of cognitive reflection and the skills associated with it to exercise control over their actions, to determine and correct their methods.

At the next stage, only those data will be considered that reflect the highest levels of formation of the studied cognitive meta-subject competencies.

First, we mean the data reflecting the number of schoolchildren who showed the fourth level of formation of cognitive meta-subject competence, associated with mastering the ability to build logical reasoning, inference and draw conclusions. Thus, we are talking about schoolchildren who, when solving the four tasks proposed in the first task, carried out a meaningful logical action to build reasoning and inference in order to carry out a consistent conclusion.

Secondly, we have in mind the data reflecting the number of schoolchildren who showed the highest level of cognitive meta-subject competence development associated with the development of the initial forms of cognitive reflection and the

skills related to it to control their actions, determine and correct their methods. Thus, we are talking about schoolchildren who, when solving the three tasks proposed in the second task, carried out internal (meaningful) cognitive reflection.

Thirdly, we mean data that reflect the highest level of formation of cognitive meta-subject competence associated with the development, selection and implementation of effective methods for solving problems of a search nature, educational and cognitive tasks. Thus, we are talking about schoolchildren who, when solving the four tasks proposed in the third task, made the choice, construction and implementation of a general (meaningful) method for solving the noted tasks.

Fourth, we mean the data reflecting the highest, the fourth, level of formation of cognitive meta-subject competence associated with the mastery of the ability by schoolchildren to independently plan ways to achieve the goal. Thus, we are talking about schoolchildren who, when solving the four tasks proposed in the fourth task, carried out independent holistic (meaningful) planning of the actions necessary to achieve the desired result.

1.6. Characteristics of the highest levels of formation of cognitive meta-subject competencies

Data reflecting the highest levels of formation of cognitive meta-subject competencies - associated with the mastery of schoolchildren's ability to build logical reasoning, inference and draw conclusions; with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; with the mastery of schoolchildren's ability to independently plan ways to achieve the goal; with the development of the initial forms of cognitive reflection and the skills associated with it to control their actions, determine and correct their methods, are presented in Table 5.

Table 5 - Distribution of children among pupils of the 5th, 6th and 7th grades who carried out a meaningful construction of reasoning, a general way of solving search problems, holistic planning and internal reflection when solving the problems of the "Reasoning" method (in %).

Classes	Meaningful construction of reasoning	General way solutions problems	Holistic planning problem solution	Internal way actions
5 (198 уч.)	39,4***	57,5***	9,1	21,2**
6 (151 уч.)	55,6	64,9	14,5	34,4
7 (124 уч.)	65,3***	79,0***	17.7	40,3**

Note: ** - $p < 0.01$; *** - $p < 0.001$.

The data given in the table testify to the following characteristics of the

formation of cognitive meta-subject competencies during the period of schoolchildren's education in grades 5-7 of the basic school.

Firstly, in the fifth grade, the competence associated with the choice and implementation of effective methods for solving problems of a search nature, in particular with the choice of a general method, is the most formed - 57.5%, the competence associated with the meaningful action of constructing reasoning is less formed - 39, 3%, the competence associated with the implementation of internal (substantial) reflection of the mode of action is even less formed - 21.1%, and the competence associated with the implementation in solving the problems of integrated planning is the least formed - 9.1%.

Secondly, in the sixth and seventh grades, this ratio in the intensity of the formation of the four competencies under discussion is preserved: holistic planning is formed the least intensively, and the meaningful construction of reasoning is the most intensive. The intensity of the formation of the other two competencies - related to the choice and implementation of effective ways to solve problems of a search nature and with the implementation of internal (substantial) reflection of the mode of action - still, just like in the fifth grade, occupies a middle position.

At the same time, the characterization of the formation of cognitive meta-subject competencies will be incomplete if one does not characterize the features of the change in the intensity of formation during the transition from class to class.

So, in the sixth grade, compared with the fifth grade, the competence associated with the logical actions of meaningful construction of reasoning is most intensively formed - the number of children with such competence increases by 16.3%, less intensively - the competence associated with internal (meaningful) reflection - the number of children with such competence increases by 12.2%, even less - the competence associated with the choice, construction and implementation of effective methods (in particular, the general method) for solving search problems - the number of children with such competence increases by 9.4% and the least intensive is the competence associated with holistic (meaningful) planning - the number of children with such competence increases by a very small amount - 5.4%.

Further, in the seventh grade, compared with the sixth grade, another competence is most intensively formed: associated with the choice, construction and implementation of effective methods (in particular, a general method) for solving search problems, the number of children with such competence increases by 14.1%, and the competence associated with the logical actions of meaningful construction of reasoning and inference and the implementation of consistent conclusions is formed less intensively - the number of children with such competence increases by 9.7%.

The competence associated with internal (meaningful) reflection is being formed even less intensively - the number of children with such competence increases by 6.9%, and the least intensively (out of the four competencies studied) is the competence associated with holistic (meaningful) planning - the number of children with such competence increases by 3.2%.

As, in our opinion, the emerging trend can be assumed (since to substantiate this assumption requires larger surveys with the participation of schoolchildren from different regions of Russia), that a more intensive (relative to other competencies)

formation in the sixth grade of competence associated with the logical actions of meaningful construction reasoning and conclusions, as well as the implementation of consistent conclusions, is based on the fact that biology, computer science, geography and social science are studied for the first time in the curriculum in this class - such academic disciplines, a significant part of the content of which is related to the presentation of theoretical material, for the assimilation of which it is necessary to inferences and draw conclusions.

In turn, also in terms of a cautious (still insufficiently substantiated) assumption, it can be assumed that a more intensive (relative to other competencies) formation in the seventh grade of competence, associated with the choice, construction and implementation of effective methods (in particular, general methods) solving search problems, is based on the fact that algebra, geometry and physics are studied for the first time in the curriculum in the seventh grade - such academic disciplines, a significant part of the content of which is related to the solution of relevant subject problems, which involves the development of a meaningful analysis of the relevant subject material, highlighting it essential relations and the implementation on this basis of a general way of solving problems.

In general, characterizing the features of the formation of cognitive meta-subject competencies in schoolchildren during their education in grades 5-7, it should be noted that throughout the entire period, the most intensively formed competence is associated with the meaningful construction of reasoning - the number of children with such competence increases from the fifth grade to the seventh by 26.0% (the difference between the results in the fifth and seventh grades, respectively, 39.3% and 65.3% is statistically significant at $p < 0.001$ – hereinafter, the φ*Fisher test was used to determine the significance of differences).

The competence associated with the general way of solving search problems is formed less intensively during this period - the number of children with such competence increases from the fifth grade to the seventh by 21.5% (the difference in the results in the fifth and seventh grades, respectively, is 57.5% and 79.0% statistically significant at $p < 0.001$).

The competence associated with internal reflection is formed even less intensively during this period - the number of children with such competence increases from the fifth grade to the seventh by 19.1% (the difference in the results in the fifth and seventh grades, respectively, is 21.2% and 40.3 % is statistically significant at $p < 0.01$).

The competence associated with holistic planning is formed the least intensively during this period - the number of children with such competence increases by 8.6%. (the difference in results in the fifth and seventh grades, respectively, 9.1% and 17.7% is statistically insignificant.

Thus, the conducted study confirmed the initial hypothesis that cognitive meta-subject competencies associated with schoolchildren's mastery of the ability to build logical reasoning, inference and draw conclusions; with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; with the mastering by schoolchildren of the ability to independently plan ways to achieve the goal and with the development of the initial

forms of cognitive reflection and the skills associated with it to exercise students control over their actions, to determine and correct their methods, are formed in schoolchildren during the specified period of study with different intensity: the most intensively is the ability build logical reasoning, less intensively - the ability to implement effective ways to solve problems of a search nature, even less intensively - the ability to exercise cognitive reflection and control of one's actions, and least intensively - the ability to plan the achievement of a goal.

Conclusions

Data were also obtained that testify to the peculiarities of the formation in the fifth, sixth and seventh grades of cognitive meta-subject competencies related to: schoolchildren's mastery of the ability to build logical reasoning, inference and draw conclusions; with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; with the mastery of schoolchildren's ability to independently plan ways to achieve the goal; with the development by them of the initial forms of cognitive reflection and the skills associated with it to exercise control over their actions, to determine and correct their methods.

The discovered facts make it possible to more concretely present the dynamics of the development of these cognitive meta-subject competencies during the period of schoolchildren's education in the fifth-seventh grades and to characterize the following three important aspects of it.

First, the features of the formation of the studied competencies in the sixth grade in relation to the fifth grade were determined. During the noted period, the competence associated with the meaningful construction of reasoning is most intensively formed, less intensively - the competence associated with internal reflection, even less - the competence associated with the general way of solving search problems, and the least intensively - the competence associated with holistic planning.

Secondly, the features of the formation of the studied competencies in the seventh grade in relation to the sixth grade were determined. During the noted period, the competence associated with the general way of solving search problems is most intensively formed, less intensively - the competence associated with the meaningful construction of reasoning, even less intensively - the competence associated with internal reflection, and the least intensively - the competence associated with holistic planning.

Thirdly, the features of the formation of the studied competencies in the seventh grade in relation to the fifth (i.e., throughout the entire period of study in the main school under consideration) were characterized. During the noted period, the competence associated with the meaningful construction of reasoning is most intensively formed, less intensively - the competence associated with the general way of solving search problems, even less intensively - the competence associated with internal reflection and the least intensively - the competence associated with holistic

planning.

In addition, the data obtained indicate that the cognitive meta-subject competence associated with the development, selection and implementation of effective ways to solve problems of a search nature and educational and cognitive tasks is formed in a larger number of children in three grades of basic school (in the fifth, sixth and seventh) , and the competence associated with the mastery of the ability of schoolchildren to build logical reasoning, inference and draw conclusions is formed in a larger number of children in two grades of basic school (in the sixth and seventh). The remaining two competencies studied in the study were formed in the fifth, sixth and seventh grades in a smaller number of children.

In conclusion, the presentation of the results of the study, it should be noted that the data obtained have a significant novelty: for the first time it was established that during the period of study in the fifth, sixth and seventh grades of the basic school, cognitive meta-subject competencies are formed with different intensity: the competence associated with the mastery of the ability to build logical reasoning, inference and drawing conclusions; less intense - competence associated with the development, selection and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks; even less intense is the competence associated with mastering the initial forms of cognitive reflection and the skills associated with it to control their actions, determine and correct their methods, and the least intensive is the competence associated with schoolchildren mastering the ability to independently plan ways to achieve the goal.

In future works, it is planned to study in more detail the validity of the assumption about the influence in the sixth grade of new (in relation to the fifth grade) subjects on the intensity of the formation of cognitive meta-subject competence in schoolchildren associated with the mastery of the ability of schoolchildren to build logical reasoning, inference and draw conclusions, and the validity of the assumption about the influence in the seventh grade of new (in relation to the sixth grade) subjects on the intensity of the formation of cognitive meta-subject competence in schoolchildren associated with the development, choice and implementation of effective (in particular, general) methods for solving problems of a search nature, educational and cognitive tasks.