CHARACTERISTICS OF COGNITIVE COMPETENCES GRADUATES OF PRIMARY SCHOOL

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DOI:10.24412/2500-1000-2022-6-1-104-111

Abstract. *The study presented in the article is aimed at determining the characteristics of cognitive competencies formed in children by the end of elementary school. As a result, it was shown that training in developing curricula aimed at forming the foundations of theoretical thinking in children provides a higher level of formation of cognitive competencies than training in traditional programs.*

Keywords: *primary school graduates, cognitive competencies, traditional curricula, programs for the formation of the foundations of theoretical thinking, the "Derivation" method.*

1. Introduction

The modern Primary Education Standard contains a number of requirements for the meta-subject results of children mastering the basic educational program of primary general education. In particular, it is noted that cognitive meta-subject results should reflect the development by students of cognitive competencies related to ways to solve problems of a search nature, with the formation of the ability to plan, with mastering the initial forms of cognitive reflection, using sign-symbolic means, with improving the logical actions of constructing reasoning [5].

Achieving the noted results should create conditions for primary school graduates to master the basic educational program of basic general education. Thus, determining the characteristics of the cognitive metasubject results achieved by schoolchildren is an important task of educational psychology. The solution of this problem will make it possible to obtain the data necessary to improve the effectiveness of education in the basic school, in particular, at its very beginning - the fifth grade.

The purpose of our experimental work was to determine the characteristics of the formation of cognitive meta-subject results in elementary school graduates related to the development of a method for solving problems, cognitive reflection, planning for solving problems, sign-symbolic actions and logical actions for constructing reasoning. Our study involved children aged 10–11 who studied in primary school in different educational environments (traditional and built according to the system of D. B. Elkonin and V. V. Davydov, associated with the formation of the foundations of theoretical thinking). This approach will allow obtaining more diverse data on the characteristics of the cognitive meta-subject results of primary school graduates than in the case when schoolchildren who studied in one (of the two indicated) educational environments participate in the study.

We assumed that the education of children in an educational environment built according to the system of D. B. Elkonin and V. V. Davydov, to a greater extent than their education in a traditional educational environment, contributes to the achievement of the noted cognitive metasubject results.

The basis of the methodological approach when considering the characteristics of cognitive metasubject results related to the development of methods for solving problems, the implementation of cognitive reflection, the planning of solving problems, the performance of sign-symbolic actions and the logical actions of constructing reasoning, were the provisions on two types of cognitive activity developed in dialectical logic and realized in the studies of V.V. Davydov [2] and in the works of his followers (see, for example, [1, 3, 4])

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 ex-

ternal 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 a condition for the discovery of the corresponding regularity. 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 objects of knowledge. In this case, it is impossible to reveal the reasons for the change in the cognizable object and clearly identify the patterns of its existence in the past, present and future.

Relying on the noted provisions on the content and methods of two types of cognition, as well as on the following from these provisions, the concept of two types of thinking, theoretical and empirical [3], we assumed that the nature of the development of methods for solving problems is determined by the type of analysis of the conditions of tasks as a special cognitive an action that is associated with the analysis of the conditions of the tasks.

In some cases, such an analysis is implemented as a formal analysis, which only divides the conditions of problems into separate data - this is typical for a non-generalized, empirical approach to solving problems. In other cases, the analysis of conditions is connected not only with the selection of data and their relationships, but, most importantly, with the clarification of their role in a successful decision: which of them is essential and necessary, and which is insignificant and accidental. This is a meaningful, clarifying analysis, characteristic of a generalized, theoretical approach to solving problems. In the course of such an analysis, in contrast to the previous case, the search for significant relationships in the content of problems occurs through a purposeful transformation of their conditions.

Such a transformation could be observed in one of our experiments with younger schoolchildren when solving the following problem: “If we use a lever bowl balance and put only one coin on each bowl when weighing, then in order to detect a counterfeit (lighter) coin from seven data, three weighings are required. How many weighings does it take to find the counterfeit coin among 41?”

As expected, some children tried to guess the answer by saying different numbers. At the same time, they did not seek to understand the first part of the condition of the problem, which, in fact, is a rule, using which one can answer the question posed. True, it is not easy to apply it, since it is not given in a general form, but in the form of solving a specific problem.

Other children paid attention to this rule, but did not analyze it, but strove, having calculated the ratio of the number of coins to the number of weighings, to immediately answer the question of the problem. So, they divided 7 by 3 in order to find out how many coins fell on one weighing - it turned out 2 and one third of the coins. Then, to find out the solution to the proposed problem, they divided 41 by 2 and one third. As a result, it turned out that it takes 17 and 4/7 weighings to find a counterfeit coin among 41.

Thus, the children of this group acted formally, empirically, using dissecting analysis. In this case, the conditions of the problem are only divided into data on the number of coins and data on the number of weighings - the children simply compared the present case (“three weighings are required for seven coins”) with the proposed task (“find out the number of weighings for 41 coins”).

The third group of children acted differently. They began to study the conditions of the problem and set themselves a goal specific to meaningful analysis: to find out why it takes three weighings to check seven coins, thereby wanting to understand this rule. To do this, they changed the condition of the original problem, figuring out how many weighings would be needed to check three coins, four, five, six. As a result of comparing the answers to these questions, an essential relation of the problem was identified: the number of weighings is equal to either half of the number of coins being checked, or half of this number reduced by one.

Based on this dependence, the children of this group easily coped not only with the question of the proposed task, but also with other similar ones: “For how many weighings can 79 coins be checked?… 111?… 237…?”

Thus, the described transformation of the conditions allowed the children to meaningfully analyze one task and highlight the essential dependence of its data. Thanks to this, they have the opportunity to successfully solve any problems where it is necessary to determine the number of weighings of a particular number of coins.

Cognitive reflection in solving problems is associated with a person's consideration of the way of his actions in the course of this solution [2]. Depending on the purpose for which the noted examination is carried out, what is supposed to be established in this case, it is necessary, in accordance with the above provisions on the two types of cognitive activity, to distinguish between two types of consideration of the mode of action, or two types of reflection as a person's appeal to his own actions.

So, if the consideration of the mode of action is carried out in order to find out what operations need to be performed, what needs to be done specifically in order to obtain the required result, then in this case a person is aware in his actions only of their visual characteristics. This level of consideration of the mode of action is characterized by the awareness of its features given in direct perception, and is called external or formal reflection, since it reflects the connection of the implemented mode of action only with random and single conditions for its implementation.

If the consideration of the method of action is carried out in order to find out not only what specific operations it consists of, but also why this action is performed in this way and not otherwise, then a person realizes the features of the method of his actions, relying on his consideration in full. This means that in this case a person takes into account not only the visual, external characteristics of the method of action when solving a problem, but also its hidden, not directly observable characteristics associated with the essential data relationships in the condition of this problem. This level of consideration of the method of action is called internal or meaningful reflection, since it reflects the connection of the method of action in solving problems not only with random circumstances, but, most importantly, with the necessary conditions for its implementation.

When analyzing the features of planning, two approaches were considered, in accordance with the provisions on two types of cognitive activity, when developing a program of action in a situation of solving problems. Within the framework of one approach, the solution of search problems includes two stages - research and execution. At the first stage, there is an analysis of the conditions of the proposed problem, associated with the selection in these conditions, both of the proposed data and their relationships. Based on this selection, a plan for solving the problem is drawn up. 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 here that all the required actions in this case are outlined before the start of 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 with 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 for the formation of logical actions for constructing reasoning, the fact was taken as a basis that in one case the derivation of a con-

clusion is based on taking into account and correlating with each other all the judgments proposed in the condition and question of the task.

So, for example, the correct solution of the problem: “Baranov's car was going faster than Vershinin's car. Baranov's car was driving slower than Rodionov's car. Whose car was the fastest? associated with the correlation of the three judgments of the problem.

Firstly, we can correlate the judgment “Baranov’s car was driving faster than Vershinin’s car”, the judgment “Baranov’s car was driving slower than Rodionov’s car” and the question “Which car was driving the fastest?”. With such a correlation, it turns out that in one judgment the relation of the compared subjects is different from that which exists in another judgment and in the question. As a result, the attitude in this judgment should be reversed: "Rodionov's car was faster than Baranov's car."

Secondly, correlating the changed judgment with another judgment and question allows us to conclude that Rodionov's car was the fastest, since his car was faster than Baranov's car, whose car, in turn, was faster than Vershinin's car. This conclusion is the answer to the question of the problem: “Which car was driving the fastest?”

In another case, the derivation of the conclusion is based on taking into account and correlating with each other only a part of the judgments proposed in the condition and question of the problem. As shown by individual experiments with logical problems based on relative asymmetric judgments, children in the problem under consideration usually correlate the judgment “Baranov’s car was faster than Vershinin’s car” and the question “Which car was the fastest?”, without taking into account the judgment "Baranov's car was driving slower than Rodionov's car." And after such a correlation, the conclusion is made: "Baranova's car was the fastest."

In the first case, therefore, children consider all the data proposed in the task, which allows them to perform a meaningful action of constructing reasoning. In the second case, children consider only a part of the data proposed in the task, thereby performing the formal action of constructing reasoning.

When considering the features of sign-symbolic actions, it was assumed - in accordance with the above provisions on two types of cognitive activity - that in one case, when operating with sign-symbolic means, a person acts meaningfully, since he considers part of the conditions of the task (for example, artificial words) within the framework of symbolic, representative function, focusing on the relationship "signifier - signified". In another case, when operating with sign-symbolic means, a person acts formally, since he considers the noted phenomena outside the framework of the symbolic function, outside the context of the “signifier-signified” relationship.

2.Materials and methods

Our study included two series of group experiments on the material of the "Derivation" technique. The first series was held at the end of the school year with 103 fourth-grade students (traditional educational program), the second series was conducted with 69 fifth-grade students at the beginning of the school year, who were studying in elementary school according to the educational program built according to the system of D.B. Elkonin and V. V. Davydov.

The "Derivation" technique included 20 plot-logical tasks of varying complexity. Each student received a form with the conditions of the tasks and answer options.

FORM

1. Borya is more fun than Gena. Gena is more fun than Nina. Who is the funniest of all? a) Gena b) Nina c) no one knows who d) Borya

2. Katya is stronger than Roma. Roma is stronger than Misha. Who is the weakest of all? a) Roma b) no one knows who c) Misha d) Katya

3. Zhanna is darker than Sveta. Zhanna is lighter than Petya. Who is the darkest of all?

a) Sveta b) Petya c) impossible to recognize d) Zhanna

4. Valya is heavier than Fedya. Valya is lighter than Tanya. Who is the lightest?

a) Tanya b) Fedya c) Valya d) it is impossible to recognize

5. Prs is more fun than Ldv. Prs is sadder than Kvsh. Who is the saddest of all?

a) Ldv b) Prs c) it is impossible to know d) Kvsh

6. Vsnch is weaker than Rptn. Vsnch is stronger than Gshds. Who is the weakest of all?

a) Gshds b) cannot be recognized c) Vsnch d) Pptn

7. Sveta iaee than Masha. Masha iaee than Dasha. Who iaee all?

a) no one knows who b) Dasha c) Sveta d) Masha

8. Olga tprk than Yana. Yana tprk than Glasha. Who tprk everyone?

a) Yana b) impossible to understand c) Olga d) Glasha

9. Nmkr oaee than Knvt. Knvt oaee than Gshds. Who oaee all?

a) it is impossible to know b) Gshds c) Knvt d) Nmkr

10. Prfsh klmn than Sdvt. Sdvt klmn than Bknp. Who is the klmn of all?

a) Bcnp b) Sdvt c) cannot be solved d) Prfsh

11. A squirrel is lighter than a butterfly. The squirrel is heavier than the bear. Who is the lightest?

a) no one knows who b) butterfly c) bear d) squirrel

12. The horse is lower than the cat. The horse is taller than the giraffe. Who is the highest?

a) a cat b) no one knows who c) a giraffe d) a horse

13. Volov is 69 years younger than Zhukov and 7 years older than Lozov. Who is the youngest?

a) Lozov b) Volkov c) no one knows who d) Zhukov

14. Utkin is 3 kg lighter than Gusev. Utkin is 74 kg heavier than Komarov. Who is the heaviest of all?

a) no one knows who b) Gusev c) Komarov d) Utkin

15. Vitya walked more slowly than Tolya. Vova walked faster than Vitya. Who walked faster?

a) Tolya b) Vitya c) Vova d) no one knows who

16. Borya is more active than Viti. Dima is more passive than Borya. Who is more passive?

a) Vitya b) no one knows who c) Boris e) Dima

17. Galya is more fun than Dasha, and easier than Sveta. Galya is sadder than Sveta, and harder than Dasha.

Who is the saddest of all? a) Dasha b) no one knows who c) Galya e) Sveta

Who is the heaviest of all? a) Dasha b) no one knows who c) Galya e) Sveta

18. Nadia is darker than Nastya and younger than Galya. Nadia is lighter than Galya and older than Nastya.

Who is the darkest of all? a) Nadia b) Nastya c) Galya d) impossible to recognize

Who is the youngest? a) Nadia b) Nastya c) Galya d) impossible to recognize

19. Ira is more fun than Rita. Rita is lighter than Lara. Lara is stronger than Ira. Ira is heavier than Lara. Lara is sadder than Rita. Rita is weaker than Ira.

Who is the funniest? a) Ira b) no one knows who c) Rita d) Lara

Who is the lightest? a) Ira b) no one knows who c) Rita d) Lara

Who is the strongest? a) Ira b) no one knows who c) Rita d) Lara

20. Petya is stronger than Roma. Roma is younger than Seva. Seva is lower than Petya. Petya is older than Seva. Seva is weaker than Roma. Roma is taller than Petya.

Who is the strongest? a) Roma b) Petya c) no one knows who d) Seva

Who is the oldest? a) Roma b) Petya c) no one knows who d) Seva

Who is the highest? a) Roma b) Petya c) no one knows who d) Seva

* * *

After handing out sheets with tasks, the children were told: “You have been given sheets with the conditions of 20 tasks. Look at them. The first four tasks are simple: to solve them, it is enough to read the condition, think and underline the name of only one person - the one who, in your opinion, will be the funniest, strongest or fastest of those referred to in the task.

Further, in problems 5 to 10, random combinations of letters are used. They replace our usual words. In problems 5 and 6, these combinations (for example, iaee or tprk) denote words such as more fun, faster, stronger, etc. In problems 7 and 8, letter combinations replace ordinary people's names. In problems 9

and 10, letter combinations replace both ordinary names of people and words such as sadder, slower, weaker, etc. When you solve these six problems, you can "in your mind" (silently, to yourself) substitute clear, ordinary words instead of combinations of letters.

In tasks 11-14, one answer must be underlined, in tasks 15 and 16 one or two answers can be underlined, whichever one thinks is more correct.

In problems 17 and 18, you need to underline the answer for each of the two questions, and in problems 19 and 20, for each of the three questions.

Some problems have no solution. If such a task comes across, then underline the answer “it is not known who” or “it is impossible to know”. Solve problems carefully and independently”.

In this methodology, tasks 1 - 4 are designed to determine the formation of logical actions for constructing reasoning (on the material of asymmetric relational judgments). If all the problems are solved correctly, then this means that when solving this group of problems, the construction of reasoning was associated with the implementation of meaningful actions of correlating judgments.

Tasks 5 - 10 are designed to determine the formation of sign-symbolic actions. If all the tasks of this group are solved correctly, then this means that when solving them, the student operated meaningfully with sign-symbolic means, took into account the symbolic function of a part of the data presented in the conditions of these tasks.

Tasks 11 - 14 are designed to determine the formation of actions to develop a way to solve them. If all the tasks of this group are solved correctly, then this means that as a result of meaningful actions to analyze their conditions, the student has developed a general way to solve them.

Tasks 15 - 16 are designed to determine the formation of the initial forms of cognitive reflection. If, when solving problem 15, the student indicates, as an answer, that Kolya and Vova walked faster, and when solving problem 16, that Vitya and Dima were easier, then these facts testify to the student’s meaningful reflection, since such answers are based on the completeness of his orientation in their actions, associated with taking into account and correlating both judgments when considering the conditions of the tasks.

Tasks 17 - 20 are designed to determine the formation of planning for solving problems, which is associated with the ability to act "in the mind", in the internal plan. When solving these problems, it is required to operate mentally with a relatively large (compared to the previous 16 tasks) number of judgments, thereby performing more complex reasoning.

If all tasks (from 17 to 20) are solved correctly, then this means that when solving them, the student's planning had an exploratory stage associated with the development of a program of his actions, and was realized as a meaningful action.

The first series involved (at the end of the school year) 103 grade 4 students studying in a traditional educational environment (contingent 1), in the second series (at the beginning of the school year) - 69 grade 5 students studying according to the system of D.B. Elkonin and V.V. Davydova (contingent 2).

3. Results

Table. The results of the children of contingents 1 and 2 performing meaningful actions in solving the problems of the " Derivation " methodology (in %)

Contingents	Cognitive metasubject outcomes				
	Cognitive reflection	Problem solving planning	Building reasoning	Development way solutions tasks	Sign-symbolic operations
Contingent 1	14,6	20,3	55,3	53,4**	51,5*
Contingent 2	23,2	30,4	66,7	71,1**	65,2*

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

The data given in the table indicate differences in the level of formation of cognitive meta-subject results of students studying in different educational environments: traditional (contingent 1) and built according to the system of D.B. Elkonin and V.V. Davydov (contingent 2).

Thus, the greatest differences in the psychological resources of cognitive development between both contingents are in relation to the formation of cognitive competencies associated, firstly, with the development of a method for solving problems and, secondly, with the performance of sign-symbolic actions. In the first case, in contingent 1, tasks 11-14 were successfully solved by 53.4% of students, and in contingent 2 - 71.1% (differences in the noted indicators are statistically significant, - at $p < 0.01$), in the second case, tasks 5-10 were successfully solved, respectively: 51.5% and 65.2% (differences in the noted indicators are statistically significant, at $p < 0.05$).

In addition, there are also significant (but statistically insignificant) differences between the contingents of students under consideration in relation to the level of formation of cognitive competencies associated, firstly, with cognitive reflection, secondly, with planning for solving problems, and thirdly, with building reasoning. In the first case, in contingent 1, when solving problems 15 and 16, 14.6% of students carried out a meaningful cognitive reflection, and in contingent 2 - 23.2%, in the second case, the solution of problems 17 - 20 was meaningfully planned, respectively: 20.3% and 30.4%, in the third case, when solving problems 1-4, meaningful actions for constructing reasoning were performed, respectively: 55.3% and 66.7%.

Thus, the presented data indicate a higher level of formation of cognitive metasubject results in children who studied in the educational environment according to the system of D.B. Elkonin and V.V. Davydov. This fact can be explained by the fact that when studying in an educational environment according to the system of D.B. Elkonin and V.V. Davydov, children purposefully form learning activities, including the formulation of a learning task and learning actions aimed at solving it.

The meaning of setting an educational task for students is to form meaningful actions in children, related, in particular, to the development of a general method for solving a certain class of tasks based on the allocation of a relationship that is essential for their construction and the performance of sign-symbolic actions to model the selected relationship.

In addition, when solving a learning problem, meaningful actions are formed that are also related to planning, since when solving a learning problem, it is necessary to develop a series of tasks that can be solved in a general way, and with cognitive reflection, since the necessary learning actions when solving a learning problem are actions to control the student for correctness. their learning activities.

At the same time, the need for students, when solving a learning problem, to justify their proposed series of problems (solved on the basis of the previously identified essential relationship) and to argue the assessment of the correctness of their learning actions, create favorable conditions for the formation of meaningful actions for constructing reasoning.

In contrast to the indicated features of teaching younger students in an educational environment built according to the system of D.B. Elkonin and V.V. Davydov, when teaching children in a traditional educational environment, educational activities related to the setting of educational tasks are not organized, and learning activities, necessary for solving educational problems are not formed.

In general, the study made it possible to characterize the cognitive meta-subject results achieved by children at the stage of transition to the main school, and confirmed the initial hypothesis that the education of children aged 10-11 years in an educational environment built according to the system of D.B. Elkonin and V.V. Davydova, to a greater extent than their training in a traditional educational environment, contributes to the formation of cognitive competencies that characterize the psychological resources of the cognitive development of younger students.

4. Conclusion

The results of this study allow us to formulate the following statements.

Firstly, the discovered facts make it possible to more specifically characterize the cognitive meta-subject results achieved by primary school graduates when studying in different educational environments: traditional and built according to the system of D.B. Elkonin and V.V. Davydov.

Secondly, the data obtained indicate that learning in an educational environment built according to the system of D.B. Elkonin and V.V. Davydov allows achieving higher cognitive meta-subject results than learning in a traditional educational environment.

Particular, the cognitive metasubject results associated with the development of a method for solving problems and the performance of sign-symbolic actions were formed in children when studying in an educational environment built according to the system of D.B. Elkonin and V.V. Davydov, significantly (statistically significant) higher level than in the traditional educational environment.

Thirdly, the distribution of children aged 10-11 years old who achieve cognitive meta-subject results by performing meaningful actions was established: less than half of the children who studied in different educational environments carried out cognitive reflection and ways of solving problems and sign-symbolic actions.

In general, the study obtained new data characterizing the cognitive meta-subject results achieved by children at the stage of transition to the main school.

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ХАРАКТЕРИСТИКА ПОЗНАВАТЕЛЬНЫХ КОМПЕТЕНЦИЙ ВЫПУСКНИКОВ НАЧАЛЬНОЙ ШКОЛЫ

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Аннотация. *Исследование, изложенное в статье, направлено на определение характеристик познавательных компетенций, сформировавшихся у детей к концу начальной школы. В результате было показано, что обучение по развивающим учебным программам, нацеленным на сформирование у детей основ теоретического мышления, обеспечивает более высокий уровень сформированности познавательных компетенций, чем обучение по традиционным программам.*

Ключевые слова: *выпускники начальной школы, познавательные компетенции, традиционные учебные программы, программы формирования основ теоретического мышления, методика «Вывод».*