

MASTER OF REGULATORY UNIVERSAL ACTIONS BY CHILDREN AGED 11-12 YEARS AS A PSYCHOLOGICAL RESOURCE FOR COGNITIVE DEVELOPMENT

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Abstract. *The article presents a study of the psychological resource of the cognitive development of children aged 11-12 years. As components of this resource, competencies were studied, reflecting the development by children of regulatory universal actions associated with reflection on the way of solving problems and planning to achieve a result. As a result of carrying out group experiments on the material of plot-logical tasks, it was shown that within two years the mastering of reflection on the method of solving problems occurs more intensively than mastering the planning of achieving a result.*

Keywords: *children 11 and 12 years old, reflection on the way of solving problems, planning to achieve a result, plot-logical tasks.*

The FSES BGE [4] States that the development of the main educational program of secondary classes by children, in particular, the fifth and sixth, 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 metasubject results. The latter involves the development of students of universal education, in particular, regulatory associated, including, with the reflection method of solving problems (control, evaluation and correction of student's own search actions) and planning to get the desired result (development and comparison of different programmes for the achievement of the goal).

In the interpretation of the forms of reflection method of solving tasks and the related skills to monitor, assess and adjust search operations, as well as in the interpretation of the characteristics of the formation of the ability to plan ways to achieve the goal, we relied on the representations 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, e.g., [1, 3]).

According to these concepts, a person who knows 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 empirical, formal, and 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 known, which is the basis for the development of the corresponding regularity.

The second case is characterized by insufficient effectiveness 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 causes of changes in the object being known and reliably characterize the patterns of its existence in the past, present, and future.

Based on the ideas about the content and methods of different types of cognition, an understanding of the features of the types of meta-subject competencies that are formed in students during training based on their development of regulatory universal actions was developed.

It was assumed, in particular, that in one case, the reflection of methods for solving problems and related control, evaluation and correction of search actions may be associated with a person's reference to the foundations of these methods and with understanding the features of their development as relat-

ed to significant relationships in the conditions of the proposed tasks.

In another case, the reflection of ways to solve problems and related control, evaluation and correction of search actions can be associated with a person's appeal only to the external features of these methods without understanding their objectively existing connections with essential relationships in the conditions of the problems being solved. In the first case, the reflection of ways to solve problems is implemented as a meaningful action, and in the second case – as a formal action.

In accordance with the above concepts of two types of knowledge, when analyzing the features of planning, two approaches to developing an action program to achieve the desired result were considered. Within the framework of one approach, planning for solving search problems includes two stages: research and performance.

At the first stage, the conditions of the proposed problem are analyzed, which is associated with identifying data and their relationships in the conditions and drawing up a plan for solving the problem. The content of planning at this stage is to determine the sequence of all actions required for a successful solution of the problem, and to develop a full program for the implementation of previous and subsequent actions to solve the problem. It is important to emphasize that all the necessary actions in this case are planned before the implementation of the solution to the proposed problem.

In the other approach, there is no research stage associated with analyzing the conditions of the proposed problem and planning its solution in General. With this approach, the plan is drawn up in parts, each of which may include one or more required actions. In this case, subsequent actions are scheduled only after the previous actions are completed.

Planning based on the first approach is carried out as a meaningful action, since the program of actions for solving the problem is developed based on the analysis of the entire volume 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, on separate links, without understanding the content of previous and subsequent actions and their relationships within the entire set of actions to solve the proposed problem.

The purpose of this study was to determine the characteristics of metasubject competencies that are formed on the basis of the development of students in grades 5 – 6 of regulatory universal actions related to the reflection of the method of solving problems and planning the way to achieve the goal.

The study was based on the assumption that regulatory metasubject competencies – related to students' mastering the ability to independently plan ways to achieve goals and with their mastering the initial forms of cognitive reflection and related skills to control their actions, determine and adjust their methods – are formed in students during the specified period of training with different intensity: more intense – the ability to exercise cognitive reflection and control their actions, less intense – the ability to plan goal achievement.

Materials and Methods

The diagnostic group session was conducted on the basis of the "Conclusions" method as follows.

At the beginning of the diagnostic session, students are given sheets with the conditions of the tasks of two tasks and blank sheets for recording answers.

TASK 1

Training problems

1) Kolya and Vasya drew animals. Some of them used seven wound paints, some-only four. Bob did not use four clasky. How many of the inks used a Kohl's?

2) Nina, Lyuba and Masha were knitting clothes. Some of the girls were knitting a hat, some a sweater, some a scarf. What did Lyuba knit if Masha didn't knit a scarf and Nina didn't knit a scarf and a sweater?

Main problems

1. Two boys were engaged in Boxing, one in wrestling. What kind of sport did Yura play if Kolya and Yura, Kolya and Sasha played different sports?

2. 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: guitar and flute?

3. 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 stamps?

Opinions about main problems

Several 5th grade students solved these basic problems and expressed their opinions about these problems.

Tanya said: "Problems 1, 2, and 3 are similar."

Kolya did not agree: " Problems 1, 2, and 3 are different."

Vika: "I think that problems 1 and 2 are similar, but problem 3 is different from them."

Katya: "I think that problems 1 and 3 are similar, but problem 2 is different from them."

Nina: "I'm sure that problems tasks 2 and 3 are similar, but problem 1 is different from them."

Which of the students is right?

TASK 2

Training problems

1) Petya is older than Misha. Misha is older than Fedya. Who is the youngest?

2) Lisa jumps higher than Natasha. Lisa jumps lower than Marina. Who jumps the highest?

3) Slava and Kostya swim at the same speed. The glory swims slower than him. Who swims the fastest?

Main problems

1. The pencil is thicker and longer handle of the pen. A pencil is thinner than a felt-tip pen and shorter than a pen. Which item is the thinnest and which is the shortest?

2. Yura and Olya Spruce, Yura and Olya, Azov was sitting on the bench. Both Jura were nearby and both Azov were nearby. Where was it (in the middle or on the edge) Olya Elova?

3. the Guys came out at the same time: Borya from Tula to Yaroslavl, Sasha from Yaroslavl to Ruza, Gena from Ruza to Tula. After 2 days, it turned out that Sasha is closer to Yaroslavl than Borya is to Tula, and Gena

is further from Ruza than Borya is from Tula. Who went the slowest?

4. Misha runs faster than Oli, 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 the slowest, who jumps the lowest, who dives the worst?

Further, the organizer of the sessions (psychologist or pedagogue) explains: "Look at the task sheet. In the first task, you first need to solve two training problems, then – three main ones. After that, you need to read the students' opinions about these three problems, and then on a blank sheet you need to specify the name of the student whose opinion you consider the most correct. And write briefly why this opinion is the most correct.

In the second task, you need to solve first three training problems, then four main ones."

Further, children are recommended to: "To properly solve any problem you first need it a few times to read silently ("myself") in order not to disturb the neighbors, then you need to think (too silently) and then it will be clear the solution you need on a blank sheet to write on top of the word "Task 1", then the numbers 1 and 2 of the training task and a number of answers and then the numbers of the main problems with answers. Next, you need to write the word "Task 2" and then, as in task 1, write the numbers of training problems and next to the answers and numbers of the main problems with answers.

Solve problems only mentally, "in your mind", you can't make any notes on task forms or answer sheets. Act carefully and independently."

In the "Conclusions" method, each of the two tasks has a special meaning.

Task 1 is intended to determine the meta-subject competence associated with the implementation of reflection on the method of solving problems, in particular, when solving problems in a verbal and symbolic form.

The children had to solve three main problems: two of them — problem one and three – are based on one principle, and one problem – the second – is based on another principle. After solving these three tasks, you had to choose one opinion about them from the five suggested ones.

A meaningful generalization of the method of action in solving the first and third problems, as a manifestation of the implementation of meaningful, internal reflection, is reflected in the choice of Katya's opinion ("...problems 1 and 3 are similar, but problem 2 differs from them..."). This choice indicates that the child knows the reasons for their actions, in particular, that these two tasks are equally constructed and 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 problems conditions, then he chooses any opinion except the fourth.

If the child correctly solves three problems and chooses the first, second, third, or fifth opinion (i.e., the opinion of Tanya, Kolya, Vika, or Nina, respectively), then it is assumed that a formal, external reflection took place during the decision. Therefore, we can conclude that the meta-subject competence associated with the implementation of reflection on ways to solve problems is relatively insufficient.

If the child correctly solves three problems and chooses the fourth opinion (i.e. Katya's opinion), then it is assumed that there was a meaningful, internal reflection in the decision. This fact gives grounds to conclude that the meta-subject competence associated with the implementation of reflection on ways to solve problems is relatively well formed.

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 a manifestation of formal, or, moreover, meaningful reflection. This fact should be qualified as a manifestation of the lack of reflection.

Task 2 is designed to determine the formation of meta-subject competence related to planning problem solving (in a verbal and symbolic form, which reflects the development of the ability to act "in the mind").

As part of this task, children were asked to solve four main problems that do not have an internal content unity and a common solution method. When solving each of the next four problems, it was necessary to operate in the mental plan with a gradually increasing number of judgments from problem to problem,

and thus perform more complex reasoning than in the previous problems of this task.

If all the problems are solved incorrectly, then there is a zero level of metasubject competence formation associated with planning to achieve the desired result when solving problems in a verbal and symbolic form.

If any one problem is correctly solved, then there is a manifestation of the first level of formation of the named competence; if it is decided any two problems, there is a manifestation of the second level; if correctly solved all three problems, there is a manifestation of the third level; if correctly solved all four problems, there is a manifestation of the fourth level of formation of metasubject competences related to planning achieving the desired result in solving problems in a verbal-sign form.

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

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

Children who successfully solved only one problem out of four had a higher number of marks, children who successfully solved two problems made fewer marks, and children who successfully solved three problems had the lowest number of marks. The zero level of formation of this meta – subject competence, when (as could be observed in individual experiments), the child cannot complete the required amount of reasoning even with numerous notes, indicates a chaotic correlation of the judgments proposed in the problem condition, since the child does not control his actions to solve the problem in any way.

Results and Discussion

Two series of group experiments were conducted using the "Conclusions" method. In the first series, 202 fifth – grade students participated, and in the second series, 158 sixth-grade students participated.

The results of the first task, designed to determine the formation of metasubject competence related to the implementation of reflection on ways to solve problems, are presented in table 1.

Table 1. Distribution of children among students in grades 5 and 6 who completed meaningful reflection and formal reflection when solving the tasks of the first task and did not complete any reflection (in %)

Classes	Execution when solving tasks		
	Meaningful reflection	Formal reflection	Absence of reflection
5 (202 st.)	20,8**	30,7	48,5
6 (158 st.)	32,3**	24,7	43,0

Note: ** - $p < 0.01$.

The data shown in the table show the following important characteristics of the formation of meta-subject competence related to the implementation of reflection on ways to solve problems during the period of training of schoolchildren in grades 5 and 6 of primary school.

First, in the fifth grade, the number of children who had no reflection when solving tasks in task 1 – 48.5% – is almost half of the population of this age who participated in the study. At the same time, the number of children who had no reflection when solving tasks in task 1 exceeds the number of children in each of the other two groups (with content reflection, 20.8%, and with formal reflection, 30.7%). It is also important to note that the number of children with formal reflection exceeds the number of children with meaningful reflection.

Second, in the sixth grade, in contrast to the fifth grade, the number of children with content reflection (32.3%) exceeds the number of children with formal reflection

(24.7%). At the same time, it should be noted that just as in the fifth grade, the number of children with meaningful reflection is inferior to the number of children who did not have reflection when solving problems, respectively, 32.3% and 43.0%.

Describing the formation of competencies related to different types of reflection methods of solution of problems during training students in fifth and sixth grades in General, it should be noted that the greatest increase in the number of children with meaningful reflection occurs in the sixth grade compared to fifth grade, 13.2% from 20.8% in fifth grade to 32.3% in the sixth grade (the difference of these results is statistically significant at $p < 0.01$, – hereinafter to determine the significance of differences test was used *Fisher).

The results of the second task, designed to determine the formation of metasubject competence related to planning the way to achieve the goal when solving problems in verbal and symbolic form, are presented in table 2.

Table 2. Distribution among 5th and 6th grade students of children who showed zero, first, second, third and fourth levels of competence related to independent planning of the way to achieve the goal (in %)

Classes	Levels of planning formation				
	Fourth	Third	Second	First	Zero
5 (202 st.)	9,5	31,7	36,6*	15,3**	6,9
6 (158 st.)	14,5	24,1	26,6*	29,1**	5,7

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

The data shown in the table indicate a number of characteristics of the formation of meta-subject competence associated with

planning the way to achieve the goal when solving problems in verbal and symbolic

form, during the period of training of schoolchildren in grades 5 and 6 of primary school.

First, 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 – 9.5% and 31.7%, respectively. In addition, the number of children with the fourth level is less than the number of children with the second level, respectively, 9.5% and 36.6%, and less than the number of children with the first level, respectively, 9.5% and 15.3%. 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 higher than the number of children with the zero level, respectively, 9.5% and 7.1%,

Secondly, in the sixth grade, as well as in the fifth grade, the number of children with the fourth level of formation of the competence in question is less than the number of children with the third level – 14.5% and 24.1%, respectively. 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, 14.5% and 26.6%, and less than the number of children with the first level, respectively, 14.5% and 29.1%. At the same time, as in the fifth grade, the number of children with the fourth level of formation of the considered competence is higher than the number of children with the zero level, respectively, 14.5% and 5.7%.

Considering the features of changes in the number of each of the five groups of children who have different levels of competence associated with independent planning of the way to achieve the goal when solving problems in verbal and symbolic form, it is necessary to note the following. So, the number of three groups of children – with the fourth level of formation of this competence, the second level and the zero level - changes from the fifth grade to the sixth grade as follows. The number of children with the fourth level and the first level increases, respectively: 9.5% and 14.5%, 15.3% and 29.1%, – the difference between the last two indicators is statistically significant (at $p < 0.01$); the number

of children with the third, second and zero levels decreases, respectively: 31.7% and 24.1%, 36.6% and 26.6% (the difference between the last two indicators is statistically significant, – at $p < 0.05$), 6.9% and 5.7%.

These changes indicate that in the sixth grade (relative to the fifth grade), the number of children who are able to correctly solve at least one task related to planning the way to achieve the desired result (the first level) and children who are able to correctly solve all four tasks of this task (the fourth level) increases.

It is also important that the number of children who are not able to solve at least one task of this task (level zero), and children who are able to solve two (second level) and three (third level) tasks decreases. It can be assumed that the total decrease in the number of the last two groups of children (from 68.3% to 50.7%) is associated with an increase in the number of children with the first level (from 15.3% to 29.1%).

Thus, it can be assumed that teaching children in the fifth and, especially, sixth grade of school is a period of active development of the first level of metasubject competence: almost a third of students in the sixth grade are able to successfully plan the achievement of the required result when solving a problem in a verbal and symbolic form. Most children will probably have to master the fourth level of this competence in the next years of education in incomplete primary school – seventh, eighth and ninth grades.

So, we have considered the data obtained in experiments that characterize the features of different levels of formation of metasubject competencies in schoolchildren – students in the fifth and sixth grades of primary school – based on the development of children's regulatory universal actions related to reflection of ways to solve problems and planning ways to achieve goals.

Now we will only consider data that reflect the highest levels of formation of the metasubject competencies under study.

First, we mean data reflecting the number of students who have shown the highest level of meta-subject competence associated with the development of reflection on ways to solve problems, which involves monitoring,

evaluating and correcting search actions. Thus, we are talking about students who carried out meaningful reflection when solving the three tasks proposed in the first task

Second, we are referring to data that reflect the highest level of meta-subject competence, which is associated with the ability of students to independently plan ways to achieve

goals. We are talking about students who, when solving the four tasks proposed in the second task, carried out independent holistic planning of actions necessary to achieve the desired result.

The results that reflect the achievement of the highest levels of meta-subject competence by children are presented in table 3.

Table 3. Distribution among 5th and 6th grade students of children who carried out holistic planning and internal reflection when solving the tasks of the "Conclusions" method (in %)

Classes	Holistic planning solutions to problems	Meaningful reflection of methods problem solving
5 (202 st.)	9,5	20,8**
6 (158 st.)	14,5	32,3**

Note: ** – $p < 0.01$.

The data shown in the table indicate the following characteristics of the formation of the studied meta-subject competencies during the period of training of schoolchildren in grades 5 and 6 of primary school.

First, in the fifth grade, the competence associated with the implementation of internal (meaningful) reflection of the method of action – 20.8%, is formed to a greater extent than the competence associated with the implementation of holistic planning tasks – 9.5%, – the difference in formation is 11.3%.

Secondly, in the sixth grade, this ratio in the intensity of the formation of the two competencies under discussion remains and increases, since holistic planning is formed less intensively than content reflection: in the first case, the difference between classes is 5.0% (9.5% and 14.5%), in the second case, the difference is 11.5% (20.8% and 32.3%), which is statistically significant (at $p < 0.01$).

In General, describing the features of the formation of regulatory metasubject competencies in schoolchildren during their training in grades 5-7, it should be noted that throughout the entire period, the competence associated with internal reflection (the number of children with such competence increases from the fifth grade to the seventh by 18.0%, – the difference in results in the fifth and seventh grades, respectively, 20.8% and 38.8% is statistically significant at $p < 0.01$) is formed more intensively than the competence associated with holistic planning (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).

Conclusion

Thus, the study confirmed the initial hypothesis that metasubject competencies associated with the development of regulatory universal actions by schoolchildren (reflection of ways to solve problems and planning ways to achieve goals) are formed in children during the specified period of training with different intensity: reflection of ways to solve problems associated with monitoring, evaluating and correcting search actions is formed more intensively than planning ways to achieve goals. We also obtained data indicating the features of different levels of formation of the studied competencies in the fifth and sixth grades. regulatory meta-subject competencies related to: mastering the ability of students to independently plan ways to achieve goals and with the development of their initial forms of cognitive reflection and related skills to control their actions, determine and adjust their methods.

The revealed facts allow us to present more specifically the dynamics of the development of these meta-subject competencies during the period of training of schoolchildren in the fifth and sixth 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 this period, the competence associated with internal reflection is formed more intensively than 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 this period, the competence associated with internal reflection is formed more intensively than the competence associated with holistic planning.

Third, the features of the formation of the studied competencies in the seventh grade in relation to the fifth (i.e., during the entire period of study in primary school) were characterized. During this period (as in the fifth and sixth grades), the competence related to internal reflection is formed more intensively than the competence related to holistic planning.

At the same time, it is important to note that in each of the two classes, a smaller

number of children who participated in the study developed co-operative reflection and holistic planning.

Concluding the presentation of the results of the experiments, it should be noted that in this study, for the first time, it was established: during the period of training in the fifth and sixth grades of primary school, meta-subject competencies that reflect children's development of regulatory universal actions are formed with different intensity: competence that reflects students' reflection on ways to solve problems and related control, evaluation and correction of search actions is formed more intensively than competence that reflects children's mastery of independent planning of ways to achieve goals.

In future works, it is planned to study the characteristics of the formation of the considered competencies in seventh, eighth and ninth grade students.

References

1. Goncharov V.S. Psihologiya proektirovaniya kognitivnogo razvitiya [Cognitive Development Design Psychology]. Kurgan: 2005 [in Russian].
2. Davydov V. V. Teoriya razvivayushego obucheniya [Developmental learning theory]. Moscow:1996 [in Russian].
3. Zak A. Z. Razvitie teoreticheskogo myshleniya u mladshih shkol'nikov [Development of theoretical thinking in primary school children]. Moscow:1984 [in Russian].
4. Federal'nyi gosudarstvennyi obrazovatel'nyi standart osnovnogo obshchego obrazovaniya [Elektronnyi resurs] [Federal state educational standard of the basic general education]. Federal'nye gosudarstvennye obrazovatel'nye standarty [Federal state educational standards]. Moscow: 2010 [in Russian].

ОСВОЕНИЕ РЕГУЛЯТИВНЫХ УНИВЕРСАЛЬНЫХ ДЕЙСТВИЙ ДЕТЬМИ 11-12 ЛЕТ КАК ПСИХОЛОГИЧЕСКИЙ РЕСУРС КОГНИТИВНОГО РАЗВИТИЯ

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***Аннотация.** В статье представлено исследование психологического ресурса когнитивного развития у детей 11-12 лет. В качестве составляющих этого ресурса изучались компетенции, отражающие освоение детьми регулятивных универсальных действий, связанных с рефлексией способов решения задач и планированием достижения результата. В итоге проведения групповых экспериментов на материале сюжетно-логических задач было показано, что освоение рефлексии способов решения задач происходит более интенсивно, чем освоение планирования достижения результата.*

***Ключевые слова:** дети 11-12 лет, рефлексия способов решения задач, планирование достижения результата, сюжетно-логические задачи.*