FORMATION OF COGNITIVE UNIVERSAL ACTIONS IN YOUNGER ADOLESCENTS AS A PSYCHOLOGICAL RESOURCE FOR COGNITIVE DEVELOPMENT

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Abstract. The article presents a study of the psychological resource of cognitive development of younger adolescents. As components of this resource, we studied competencies that reflect the development of children's cognitive universal actions related to the construction of logical reasoning and the development of ways to solve problems. As a result of conducting group experiments on the material of plot-logical problems, it is shown that within two years, the development of actions for constructing logical reasoning occurs more intensively than the development of actions for developing solutions to problems.

Keywords: younger teenagers, building logical reasoning, developing ways to solve problems, plot-logical problems.

In the new Federal State Educational Standard of Basic General Education [8] was the first to formulate the requirements for the results of a meta-subject children develop the basic educational program of basic school. The implementation of these requirements involves the deployment of a complex scientific and practical work on the psychological with about Activity implementation of the standard in school education.

According to the provisions of the new FSES BGE, the mastering by children of the basic educational program of the fifth and sixth grades of basic school should lead to the achievement of subject educational results based on the assimilation of the content of programs of specific academic disciplines. However, development of children basic educational program selected school classes must, according to the new standard education, lead and to the formation of ensuring achievement metasubject results cognitive metasubject competence. The noted competencies reflect the mastery of universal cognitive actions by schoolchildren, associated, in particular, with the construction of consistent reasoning and the implementation of consistent inferences, with the development and implementation of effective ways to solve problems of a search nature, educational and cognitive tasks.

According to the above-mentioned provisions, a person who cognizes the surrounding reality can be aimed both at reflecting the internal connections and relationships of objects and phenomena, thereby realizing theoretical, meaningful, rational knowledge, and at reflecting their external connections and relationships, thus realizing 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 reasons underlying the changes in the cognized object, which is the basis for the development 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 cognition. At the same time, it is impossible to reveal the regular changes in the cognized object and fully characterize the features of its existence, both in the past and in the future.

Based on the noted provisions on the content and methods of different types of cognition, an understanding of the characteristics of cognitive meta-subject competences was developed [6]. In accordance with this understanding, the development of methods for solving problems in one case is associated with the isolation of the essential relations of
the data contained in their conditions, in the other case the disclosure of the essential relations objectively contained in the conditions of the problems being solved does not occur. The development of a solution method, associated with the selection of essential relations, is implemented as a meaningful, reasonable action, and the development of a solution method, which is not associated with the isolation of essential relations, is a formal, rational action.

When developing the criteria and indicators of the formation of skills in building logical reasoning and inference, the fact was taken as the basis that in one case, the derivation of a conclusion from the proposed judgments is based on the selection of their true relationships, in the other case, the derivation of a conclusion from the proposed judgments is based on the isolation of their false relationships.

Isolation of the true relations of the proposed judgments creates favorable conditions for demonstrating a consistently realized inference, and the allocation of false relations of judgments creates conditions for the occurrence of contradictions in the implementation of the inference. In the first case, the construction of reasoning is realized as a meaningful action, in the second case – as a formal action.

The formation of cognitive meta-subject competence, which reflects the development by students of effective ways of solving problems, presupposes mastering the action of analysis, which is associated with the study of the conditions of the problems being solved.

In some cases, such a study is carried out as a formal analysis, in the course of which, in the context of problems, individual data and their connections are distinguished. Such an analysis is typical in the development of a non-generalized, empirical way of solving problems [2-6]. When solving a number of search problems belonging to one class (i.e., built and solved on the basis of a single principle), the development of a non-generalized (private) method does not allow solving all the proposed problems successfully.

In other cases, the study of the conditions of the problems to be solved is carried out as a meaningful analysis, during which not only the selection of data and their relationships occurs, but also, most importantly, the clarification of their role in achieving the required result: what data and their relationships are necessary for a successful solution play an essential and decisive role, and which are accidental and secondary. This analysis is typical when developing a generalized, theoretical way of solving problems. When solving a number of search problems related to one class, the development of a generalized method allows us to successfully solve all the proposed problems.

The aim of the study was to determine, at the stage of transition to the main school, the formation of cognitive meta-subject competencies, reflecting the development of cognitive universal actions by children, associated, in particular, with the construction of consistent reasoning and inferences and the development and implementation of effective methods for solving search problems.

The hypothesis of the research was that the considered cognitive meta-subject competences are formed in the sixth grade more intensively than in the fifth.

This assumption is based on an analysis of the curricula in the fifth and sixth grades of basic school. It was noted that in the sixth grade, children learn new academic subjects (biology, computer science, geography and social studies). A significant part of the content of these academic disciplines, in contrast to the academic disciplines studied in the fifth grade, is associated with the presentation of theoretical material.

Based on the characteristics of different types of analysis of the conditions of search problems belonging to the same class, and associated with these types of features of different ways of solving them, requirements for an experimental situation were developed, designed to determine the nature of the solution (generalized or non-generalized) of the proposed problems.

First, the subject needs to propose to solve not one, but several problems. Secondly, these problems should have a common design and solution principle. Thirdly, their conditions must differ in external, directly observable features.
The formation of cognitive meta-subject competence, reflecting the development of students' ability to build reasoning, is based on solving logical problems with judgments of various types, in particular, with attributive (property judgments) and relational (relation judgments) [1].

In logical problems, there are two types of attributive judgments - affirmative and negative: in judgments of the first type, this or that property in relation to the subject of the statement is affirmed, in judgments of the second type it is denied.

Also in logical problems, there are two types of relational judgments, - with symmetric relations of its members and asymmetric: in the first case, when the members of the relation are exchanged, its character does not change (if \( B = G \), then, therefore, \( G = B \)), in the second case, the character the ratio changes to the opposite (if \( B \) is greater than \( G \), then, therefore, \( G \) is less than \( B \)).

On the basis of these provisions, a series of plot-logical tasks was developed. Their composition meets a number of requirements. First, the series includes tasks with judgments of the same type: attributive affirmative, attributive negative, relational, reflecting symmetric relationships, and relational, reflecting asymmetric relationships.

Secondly, the series includes tasks in the conditions of which there are judgments of different types: affirmative and negative, reflecting symmetric and asymmetric relationships.

Thirdly, at least two problems with each type of judgment and with each combination of them are included in the series.

If a student successfully solves a series of logical problems built in accordance with the specified requirements, then this indicates that when constructing reasoning in the course of solving problems, he acted meaningfully, revealing the true relations of judgments. If in such a series the student solves most of the problems or all problems incorrectly, then this means that when constructing reasoning he acted formally, without revealing the true relations of judgments and, in fact, relying on their false relations.

**Method "Assertions"**

Taking into account these approaches to the development of experimental situations in order to assess the formation of cognitive meta-subject competencies in schoolchildren, a methodology was created with the code name "Assertions". It includes two tasks, in each of which children are asked to solve several plot-logical problems.

**TASK 1**

**Training problems**

1) Natasha and Marina loved to eat fruit. Some of them ate pears and apples with particular pleasure, some tangerines and oranges. What fruit did Marina prefer to eat, if it is known that Natasha ate tangerines and oranges?

   a) tangerines and oranges,
   b) it is not known which fruit she preferred,
   c) pears and apples,
   d) oranges and lemons,
   e) tangerines and pears,
   f) this problem cannot be solved.

2) Nikolai and Vasily drew with colored pencils. Someone used three pencils of different colors (red, black, blue), someone – four pencils of different colors (brown, orange, green, yellow). Vasily did not use four pencils of different colors when drawing. How many pencils of different colors did Nikolay use to draw animals?

   a) six pencils of different colors,
   b) it is not known how many pencils of different colors Nikolay used,
   c) four pencils of different colors,
   d) five pencils of different colors,
   e) this problem cannot be solved,
   f) three pencils of different colors.

3) Svetlana, Ekaterina and Elizaveta knitted different items of clothing. Some of the girls liked to knit winter hats of different sizes in green, some liked to knit large sweaters with long sleeves in white, some liked to knit blue tracksuits. What items of clothing did Catherine knit, if it is known that Elizabeth did not knit large sweaters with long sleeves, and Nina did not knit large sweaters with long sleeves?

   a) large sweaters with long sleeves in white,
   b) it is not known what items Catherine knitted,
Main problems

1. Two girls were wearing brown jackets and one was wearing a purple coat. What was Nadezhda wearing if Maria and Ekaterina and Ekaterina and Nadezhda were dressed differently?
   a) in a brown jacket,
   b) it is not known what Nadezhda was wearing,
   c) in a purple coat,
   d) in a red and blue tracksuit,
   e) this problem cannot be solved,
   f) in a purple jacket.

2. Two girls were embroidering: one with red woolen threads, the other with blue cotton threads. What thread did Natasha embroider with if Valentina did not embroider with blue cotton threads?
   a) red woolen threads,
   b) it is not known what thread Natasha embroidered,
   c) blue cotton threads,
   d) green silk threads,
   e) this problem cannot be solved,
   f) red cotton threads.

3. Four days in August were different weather: twenty-second, twenty-fourth, twenty-seventh and twenty-eighth. One day it was cold and rainy, the next day it was warm and dry, on the third day it was warm and rainy, on the twenty-fourth of August it snowed. It was warm on the twenty-second and twenty-seventh of August, and it was rainy on the twenty-second and twenty-eighth of August. What day in August was it dry and warm?
   a) August twenty-second,
   b) it is not known what day in August it was dry and warm,
   c) the twenty-seventh of August,
   d) the twenty-eighth of August,
   e) this problem cannot be solved,
   f) the twenty-fourth of August.

4. Konstantin is much stronger than Vladimir. Constantine is a little weaker than Vasily. Alexander is much weaker than Constantine. Who is the strongest?
   a) Constantine is the strongest of all,
   b) it is not known who is stronger than everyone,
   c) Vladimir is stronger than everyone,
   d) Alexander is stronger than everyone,
   e) this problem cannot be solved,
   f) Vasily is the strongest.

Task 2

Training problems

1. Alexander and Konstantin made words from cubes with letters. First, Alexander composed the word DREAM. Then he rearranged the letters and got the word NOS. Konstantin first composed the word MIR, and then rearranged the letters in it in the same way as Alexander. What word did Konstantin get after rearranging the cubes with letters?
   a) RMI; b) MRI; c) it is not known what word came out; d) RIM; e) IRM; f) this problem cannot be solved.

2. Zinaida and Tatiana made numbers from cubes with numbers. From the beginning, Zinaida made the number 124. After that, she rearranged the cubes and got the number 214. Tatiana first made the number 634, and then rearranged the numbers in it in the same way as Zinaida. What number did Zinaida get after rearranging the cubes with numbers?
   a) 643; b) it is not known what number turned out; c) 463; d) this problem cannot be solved; e) 436; f) 364.

Main problems

1. Boris and Vladimir made words from cubes with letters. First, Boris composed the word DISK. Then he rearranged the cubes with letters and got the word IDKS. Vladimir first composed the word CRAB, and then rearranged the letters in it in the same way as Boris. What word did Vladimir get after rearranging the cubes with letters?
   a) CARB; b) CBRA; c) it is not known what word came out; d) ARCB; e) RCBA; f) it is impossible to solve this problem.

2. Gennady and Dmitry made words from cubes with letters. First Gennady composed the word BANDY. Then he rearranged the letter cubes and got a word. ABDNY. Dmitry first composed the word PIANO, and then rearranged the letters in it in the same way as Gennady. What word did Dmitry get after rearranging the cubes with letters?
a) PINAO; b) PIOAN; c) it is not known what word came out; d) IPNAO; e) APINO; f) this problem cannot be solved.

3. Elizabeth and Marina made words from cubes with letters. First, Elizabeth composed the word MALINA. Then she rearranged the cubes with letters and got a word. AMILAN. Marina first composed the word SEDOKI, and then rearranged the letters in it in the same way as Elizabeth. What word did Marina get after rearranging the cubes with letters?
   a) DESIKO; b) ICODSE; c) it is unknown what word was obtained; d) ESODIK; e) EDOSIK; f) it is impossible to solve this problem.

4. Valentina and Tamara made words from cubes with letters. First Valentina composed the word SALUTARY. Then she rearranged the cubes with letters and got the word ASULATYR. Tamara first composed the word RATIONAL, and then rearranged the letters in it the same way as Valentina. What word did Tamara get after rearranging the cubes with letters?
   a) TARIOLAN; b) ARITNOLA; c) it is not known what word came out; d) RATINAOL; e) TRINAOLA; f) this problem cannot be solved.

Task 1 is included in the method in order to clarify the features of the formation of cognitive metasubject competence, reflecting the development of students’ ability to build reasoning. Within the framework of this task, it is required to solve four problems, including judgments of different types: in the first and third problems, affirmative attributive judgments are used, in the second problem – negative attributive judgments, in the fourth problem – asymmetric relational judgments.

When assessing the formation of the ability to build logical reasoning, inference and draw conclusions, one should be guided by the following criteria.

If all the problems are solved incorrectly or some tasks have no solution at all, then this indicates the manifestation of a zero level of formation of the action of constructing logical reasoning.

If only one problem is correctly solved, and the remaining problems are solved incorrectly, or some of the remaining problems are not solved at all, then this indicates the manifestation of the first level of formation of the action of constructing logical reasoning.

If any two problems are solved correctly, and the remaining problems are solved incorrectly, or some of the remaining problems are not solved at all, then this indicates the manifestation of the second level of formation of the action of constructing logical reasoning.

If any three problems are correctly solved, and one remaining problem is either solved incorrectly, or not at all, then this indicates the manifestation of the third level of formation of the action of constructing logical reasoning.

If all problems are correctly solved, then this indicates the implementation of a meaningful action of constructing logical reasoning and, in accordance with the previous qualifications, about the manifestation of the fourth level of formation of the action.

Task 2 is included in the method in order to clarify the features of the formation of cognitive meta-subject competence, which reflects the development of effective ways of solving problems by students. Pupils are asked to solve four problems, built on the same principle (i.e., related objectively to one class).

If the student solved all four problems correctly, then in this case it is assumed that the decision is based on the selection of essential relations underlying a single principle of the solution, and, therefore, it was carried out in a general way. This gives grounds to characterize such a situation as a manifestation of the second level of formation of cognitive meta-subject competence, associated with the construction of a general method for solving problems of a search nature, based on a meaningful analysis of their conditions.

If the student did not solve four problems correctly, but solved correctly any three, two, or one of the four problems, then in this case it is assumed that the solution is not based on the selection of essential relations underlying
the single principle of the solution, and, therefore, it was carried out in a particular way. This gives grounds to characterize such a situation as a manifestation of the first level of formation of cognitive meta-subject competence associated with the construction of a method for solving problems of a search nature based on a formal analysis of their conditions.

If the student has not solved a single problem correctly, then this gives grounds to characterize such a situation as a manifestation of a zero level of formation of cognitive meta-subject competence associated with the construction of a method for solving search problems.

**Results**
The group experiments based on the method "Assertions" were attended by 51 pupils of grade 5 (contingent 1) at the beginning of the school year, 49 pupils of grade 6 (contingent 2) at the beginning of the school year and 52 pupils of grade 6 (contingent 3) at the end of the academic year. The results of solving problems by students of the indicated contingents are presented in Tables 1 and 2.

Table 1. Levels of formation of logical actions for building reasoning by the results of solving problems of task 1 by students of contingents 1, 2 and 3 (in %)

<table>
<thead>
<tr>
<th>Levels formation</th>
<th>Contingent 1</th>
<th>Contingent 2</th>
<th>Contingent 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fourth</td>
<td>51,0</td>
<td>55,1*</td>
<td>76,9*</td>
</tr>
<tr>
<td>Third</td>
<td>17,6</td>
<td>20,4</td>
<td>13,5</td>
</tr>
<tr>
<td>Second</td>
<td>11,8</td>
<td>10,2</td>
<td>5,8</td>
</tr>
<tr>
<td>First</td>
<td>11,8</td>
<td>8,2</td>
<td>3,8</td>
</tr>
<tr>
<td>Zero</td>
<td>7,8</td>
<td>6,1</td>
<td>0,0</td>
</tr>
</tbody>
</table>

Note. * p <0.05

Analysis of the data presented in table 1 allows us to note the following.

Firstly, in each contingent, a larger number of children successfully solved all four problems, thereby showing the implementation of a meaningful action of building logical reasoning.

Secondly, every year (see, respectively, the indicators of problem solving by contingent 2 and 3) the number of children who successfully solved four problems increases and, accordingly, the number of children who solved three, two, one problem or did not solve any problem decreases. It is interesting to note that after studying in the sixth grade, there are no children left who have not solved a single problem.

Thirdly, it is important to emphasize that the number of children who performed a meaningful action of constructing logical reasoning increases insignificantly during training in the fifth grade – 4.1%, and during training in the sixth grade significantly – by 21.8% (the difference in indicators 76.9% and 55.1% statistically significant: p <0.05).

Table 2. Levels of formation of methods for solving problems based on results solving problems of task 2 by schoolchildren of contingents 1, 2 and 3 (in %)

<table>
<thead>
<tr>
<th>Levels formation</th>
<th>Contingent 1</th>
<th>Contingent 2</th>
<th>Contingent 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second</td>
<td>62,7*</td>
<td>69,4</td>
<td>88,5*</td>
</tr>
<tr>
<td>First</td>
<td>23,6</td>
<td>20,4</td>
<td>9,6</td>
</tr>
<tr>
<td>Zero</td>
<td>13,7</td>
<td>10,2</td>
<td>1,9</td>
</tr>
</tbody>
</table>

Note. * p <0.05

Analysis of the data presented in table 2 allows us to note the following.

Firstly, the number of children solving problems in a general way (the second level of formation of the way of solving problems) increases in the first and second years of study in basic school in different ways: during the study in the fifth grade, the increase was 6.7%, and during learning in the sixth grade – 19.1%. As can be noted, the last increase turned out to be significantly higher (than in the first case) – by 12.4%. In general, the
number of children with the second level of formation of ways to solve problems in two years increased by 22.8% (the difference in indicators 62.7% and 88.5% is statistically significant: p <0.05).

Secondly, the number of children who solve problems in a private, non-generalized way (the first level of the formation of the way of solving problems) during education both in the fifth and sixth grades, in contrast to the number of children with the second level of formation of the way of solving problems, decreases by 14.0%. At the same time, it is important to note that in both groups of children noted, the decrease during the study in the sixth grade was greater than during the study in the fifth grade, respectively: 10.8% and 3.2%.

Thirdly, the number of children who did not solve any problem (zero level of formation of the way of solving problems), as well as the number of children with the first level of formation of the way of solving problems, decreases during studying in the fifth and sixth grades (by 11.8%). It is important to note that, as in the group of children with the first level of formation of the way of solving problems, during the study in the sixth grade, the marked decrease turned out to be more than during the study in the fifth grade, respectively: 8.3% and by 3.5%.

Thus, the data obtained indicate that after studying in the sixth grade, children who perform a meaningful action to develop an effective way of solving problems, which manifests itself in solving problems in a general way, constitute the overwhelming majority of schoolchildren of this age.

Conclusion
Based on the experimental data reflected in Tables 1 and 2, it can be argued that the study confirmed the initial hypothesis that cognitive meta-subject competencies are associated with the mastery of schoolchildren the ability to build logical reasoning, inference and draw conclusions, with the development, choice and implementation them of effective ways of solving problems of a search nature, educational and cognitive tasks, are formed during the period of study in the sixth grade more intensively than in the fifth.

The results of this study lead to the following conclusions.

First, data were obtained that testify to the peculiarities of the formation in the fifth and sixth grades of such a component of the psychological resource of the cognitive development of younger adolescents as cognitive meta-subject competences associated, in particular, with the mastery of schoolchildren the ability to build logical reasoning, inference and draw conclusions, and with the development, selection and implementation of effective methods of solving search problems, educational and cognitive tasks.

The discovered facts allow us to more specifically represent the dynamics of the development of the considered component of the psychological resource of cognitive development at the stage of transition to the main school. In particular, such an important aspect of this dynamics was revealed, which characterizes the more intensive formation of the discussed cognitive meta-subject competences in the sixth grade compared to the fifth.

Secondly, the data obtained indicate that the cognitive meta-subject competences associated, in particular, with the mastery of schoolchildren the ability to build logical reasoning, inference and draw conclusions and with the development, selection and implementation of effective methods of solving problems of a search nature, educational and cognitive tasks formed in the fifth and sixth grades in a larger number of children.

So, the study carried out on the material of the "Assertions" method, which includes tasks performed on the material of plot-logical tasks that were required to be solved in a verbal-symbolic form, showed that the educational program for children in the sixth grade creates more conditions for the formation of cognitive meta-subject competencies than fifth grade curriculum.

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ФОРМИРОВАНИЕ ПОЗНАВАТЕЛЬНЫХ УНИВЕРСАЛЬНЫХ ДЕЙСТВИЙ У МЛАДШИХ ПОДРОСТКОВ КАК ПСИХОЛОГИЧЕСКИЙ РЕСУРС КОГНИТИВНОГО РАЗВИТИЯ

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Аннотация. В статье представлено исследование психологического ресурса когнитивного развития младших подростков. В качестве составляющих этого ресурса мы изучали компетенции, отражающие освоение детьми познавательных универсальных действий, связанных с построением логических рассуждений и разработкой способов решения проблем. В результате проведения групповых экспериментов на материале сюжетно-логических задач было показано, что в течение двух лет освоение действий построения логических рассуждений происходит более интенсивно, чем освоение действий по разработке способов решения проблем.

Ключевые слова: младшие подростки, построение логических рассуждений, разработка способов решения проблем, сюжетно-логические задачи.