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Features of the Metacognition Structure for Pre-school Age Children

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Abstract

Peculiarities of the metacognition structure for children of pre-school age are considered. The methods and results of survey of 84 children 5-6 years of age are presented. Features of the children's metacognitive knowledge, processes of goal-setting, simulation of conditions for cognitive activity, programming of cognitive actions, self-control of the process and results in cognitive activity and connections between these components are described. It is shown that children's metacognition may be realized with the help of dialectic thinking.

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Key words: metacognition structure, structural-dialectical approach, pre-school age children, metacognitive knowledge, gnostic goal-setting, simulation of conditions for cognitive activity, programming of actions and self-control in cognitive activity

1. Introduction

The problem of children’s metacognitive development attracts more and more attention of scientists from different countries. Revealing of regularities for metacognition development will allow finding optimal ways of solving the most important tasks of modern education which are associated with the children’s formation of a subjective position in cognition: the ability for self-initiation, planning and control in cognitive activity.

Most researchers define metacognition as a system of peoples’ knowledge about peculiarities of their own cognitive sphere and ways to control it, which is the basis for self-regulation [1]; [2]; [3] etc. On the basis of these studies we distinguish two parts in metacognition structure: cognitive-emotional component and behavioral component. The cognitive-emotional component is a system of information about cognitive activity as a specific form of human activity: the content, methods and terms of efficiency, and also evaluation of their own individual cognitive resources (metacognitive knowledge). The behavioral component includes processes of cognition self-regulation: gnostic goal-setting; simulation of significant conditions for realization of the cognitive activity; programming of cognitive actions; self-control in the results of cognition [4]. The difference between cognition

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and metacognition deals with the subject of reflection: the result of cognition is the concept of an external object, the result of metacognition is the concept of the cognitive activity itself that becomes the basis for its implementation.

Our research belongs to the structural-dialectical approach (N.E. Veraksa, I.B. Shiyan, O.A. Shiyan and others). According to the definition by N.E. Veraksa, dialectical thinking is a process of transformation of contradictory situations with the help of specific dialectical intellectual actions and means [5]. N.E. Veraksa and O.M. Dyachenko distinguish two types of self-regulation: regulatory-stabilizing type, aimed at the assimilation and usage of the existing cultural norms, and transformative type, aimed at «the transformation of reality and the resolution of a controversial situation by dealing with the opposites» [6, p. 16]. These methods are used in cognitive activity, too. The first method of self-regulation, involving the reproduction of the adopted algorithms, can be identified as formal metacognition. The second method, involving the self-determination of the cognitive goal and means to achieve it in problem situations, is regarded as dialectical metacognition. [7, 8] In studies by I.B. Shiyan dialectical thinking is analyzed as a mean of the cognitive process organization [9]. According to these works there are two types of metacognitive structures: the formal and the dialectical ones.

Formal metacognition reflects complementary and static characteristics of cognitive activity. Dialectical metacognition reflects the cognitive process as a dialectical phenomenon – in development, in all its relations and mediations. This notion is a result of the subject’s dialectical thinking about his / her own possibilities and conditions of a specific problem. Metacognitive type manifests itself in its all structural components.

Formal metacognitive knowledge includes only external, obvious features of cognitive activity, without taking into account its dynamics. Dialectic metacognitive knowledge contains all possible, including mutually exclusive characteristics of cognitive activity, their correlations and possible changes under the influence of various factors.

The formal goal-setting directs cognition to the reflection of static, isolated objects while the dialectical goal-setting turns towards the understanding of the structural peculiarities of the phenomenon as a whole, its cognition as a part of a more complex structure, the learning of the object’s origin, the detection of its development patterns, forecasting its possible changes in the future.

Obvious and complementary conditions are fixed in the formal model of conditions for cognitive activity. All significant subjective and objective, promotional and preventing the cognition circumstances and their possible changes are taken into account in the dialectic metamodel.

Formally organized programs of cognitive actions are sequences of steps where each next step doesn’t depend on the results of the previous one. Dialectical cognitive program includes a series of dialectical cognitive actions structured to suit different options for development activities.

Formal self-control is focused on external, explicit characteristics of the learning process and results. Dialectical self-control deals with the content and quality of the work, revealing the contradictions between the expected results and the findings, their causes and ways of correction [10].

Manifestations of formal and dialectical thinking in metacognitive structures can be detected as early as the preschool years.

Studies in metacognitive psychology demonstrate that pre-school age is a sensitive period for the development of metacognitions. L. McLeod [11], M.B. Bronson [12], D. Whitebread and P. Coltman etc. [13] proved that children can verbalize metacognitive knowledge and implement cognitive control by the end of pre-school age. However, these studies lack for research in the specific content of metacognitive structures in the preschool age. This article represents our results in this sphere.

2. Methods

A conversation was made to study children’s metacognitive knowledge. It included questions about cognition as an activity ("How does a person learn new things? ", "Why is it necessary for a person to learn new things? ", "What must be done to learn anything new?") and questions about five cognitive processes (perception, thinking, memory, imagination, attention) i.e. their functions, characteristics (including dialectical ones), specific features and efficiency conditions.
The experimental situations were developed to study children’s metacognitive processes. The situations were organized in the following way: 1) a child is offered a problem situation, the resolution of which involves the development of new knowledge: “Your group was given a rare animal unknown for all kids. What should be done for proper care about this animal?”. The question stimulates the child to recognize his / her lack of knowledge and to set a cognitive goal; 2) a child is asked to identify the main elements of the content in the new knowledge (tasks of the activity); 3) a child is questioned about the subjective and objective conditions of cognitive activity; 4) a child is offered to develop a program of actions; 5) a child is suggested to realize the plan while the marks of self-control procedure are fixed; 6) a child is asked to evaluate his / her achievements. The first and the second steps help to find out features of goal-setting, the third step tells about simulation of conditions for activity, the fourth step deals with programming of the actions, the fifth and the sixth steps show the self-control in cognitive activity.

Pearson's correlation coefficient was used to analyze the correspondences between the components of metacognition.

84 children who attend senior groups of kindergartens (5-6 years of age) in Severodvinsk took part in this research.

3. Results

The quantitative analysis of the data is presented in Table 1.

Table 1. Levels of children’s metacognitive knowledge and processes (in per cent)

<table>
<thead>
<tr>
<th>Levels</th>
<th>The components of metacognition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Metacognitive knowledge</td>
</tr>
<tr>
<td>Low</td>
<td>16,8</td>
</tr>
<tr>
<td>Medium</td>
<td>64,8</td>
</tr>
<tr>
<td>High</td>
<td>19,2</td>
</tr>
</tbody>
</table>

The data demonstrate that all components are presented in the children’s structure of metacognition and their correlation is harmonious.

There were children in all groups who showed quite profound and systematic knowledge about cognition as an activity and their own intellectual resources but most children had a set of poorly differentiated, nonsystematic notions. Pre-school age children are aware of the role of knowledge in life, they differentiate cognitive processes, accurately define the functions of attention, perception, memory and imagination in obtaining, maintaining and transforming knowledge, although the specific of thinking is not understood by them. Children know about sources of information available to them (TV, books, adults), they often mention the Internet and offer empirical methods of cognition (observation and experiment). Analysis of the responses revealed the dialectical aspects for the content of children’s metacognitive knowledge. Describing the memory, thought and imagination, some children noted that there could be mutually exclusive characteristics: "Sometimes you know but you cannot remember. I had it while the holiday ", "It happens that I know everything but I cannot explain", "Sometimes I tell the truth and a bit lie". Dialectical features of perception were denied by children (having the question "Is it possible at one and the same time to see and not to see?" all children said: "No"). But nevertheless all children said that the accuracy of perception depended on such factors as lighting, noise, distance to an object. Children understood the individual differences in selectivity, volume and speed of perception. They noted the differences in speed, volume, accuracy of remembering and long-term preservation of information. They mentioned the differences in concentration, distribution and stability of attention but they paid attention in the people’s thinking only to speed differences. Most children said that success of cognitive activity depended on
external factors ("should be quiet"), a third of the subjects noted the role of cognitive skills ("you should be able to read and to use a computer") and motivation ("they don’t know because they don’t want to know") and personal qualities ("curiosity, observation, diligence").

In situations discovering lack of knowledge most children of 5-6 years old put a cognitive goal but it was difficult for them to formulate tasks. The group with a high level of goal-setting was made of children who put their own goal with cognitive orientation ("we have to learn about the animal") and referred to specific tasks. The responses were regarded as a middle level of goal-setting when a cognitive goal was hidden behind the actions of the cognitive character: "read a book", "ask the adults". Low level of goal-setting was formed by the children who couldn’t realize cognitive objectives even with the adult’s help. Analysis of the children's answers allows to divide children into two groups with a formal or a dialectical orientation. The formal orientation is manifested in the child's interest in the external characteristics of the object, the dialectical one can be represented through the desire to know the structure and dynamics the phenomenon under study (having a question: "What do you need to know about the animal for proper care about it?") children answered: "It’s necessary to know: what it eats (a predator or not), what size (small or large) it will be, where it lives (whether it likes the cold or the warmth), who lives nearby with it").

In all groups children called the objective conditions for cognition but they often included non-essential circumstances. These answers we put to an average level of development of the metamodeling process. The lower level was formed by responses in which children mentioned not related to cognition conditions: "water, cell", "chair to sit". A high level of modeling of conditions for cognitive activity was presented by answers with at least 4 essential terms: the sources of information ("book", "computer", "adult"), the external environment ("that no one made any noise ") and subjective conditions ("the ability to read", "mind", "memory"). During the discussion these children gave isolated dialectical characteristics of cognitive activity, they noted that the same tools could be effective and ineffective (e.g.: "The book can help only if you know how to read"), that experiments with animals couldn’t always be carried out because an animal "is dangerous, it can hurt".

As a high level of development of the process of programming actions we classified the answers where independently or with the help of an adult 2-4 consecutive actions were indicated. The programs made up by these children included main stages of knowledge: getting information, its interpretation (conversion, conservation) and its application, e.g.: "First, I will ask my mother – she knows a lot, or the caregiver – she also knows a lot and tells us; you can also take a picture book so it will be clearer, I always find a picture more interesting; there is a computer too; it can be seen, remembered and told everybody". This program includes a dialectical content (several options) but only at the stage of gathering information. The children didn’t describe sequence of information search in the books or algorithm of an observation or an experiment. Only 10% of children named stage of understanding. Stage of the application of knowledge means for children to use it in practice or to present new knowledge to an adult or another child ("I will do as it is written", "tell all"). The programs of the children who were rated as average had cognitive actions but they didn’t reflect the sequence of information processing. A low level means that a program of cognitive action was absent.

During the implementation of the plan we fixed procedural self-control. Analysis of the results showed that in the implementation of cognitive activity absolute majority of children forgot their own plans. When the experimenter added interesting but not important information that didn’t correlate with their planning tasks or did not use information sources they had offered children gladly cooperated and did not ask to realize their program. But when an adult admitted obvious mistakes in presenting the material, the kids noticed it. It proves that self-control of cognitive activity in the pre-school years just begins to emerge. However there were children in all groups who were good at final self-control. Having finished the work they were able to assess the achievements: they defined clear what they had learned and proclaimed the shortcomings in their knowledge. This applies to the amount of content: "Not everything is learned: I do not know how to wash the animal, with whom it can make friends, I must search more" and the quality of remembering: "I have read about everything that is needed but I do not remember all of it, it is necessary to reread". It demonstrates the formation of the senior preschool age prerequisites dialectical self-control.
Correlation analysis of the data showed that there were significant correlations between indicators of development of metacognitive knowledge and processes. The correlation between metacognitive knowledge and goal-setting, modeling conditions, programming, self-control – \( r = 0.64; 0.66; 0.55; 0.52, p = 0.01 \). Children with high levels of metacognitive knowledge could adequately assess their cognitive potential, so they formulated gnostic goals more accurately, defined the conditions and means of achieving them, built the program of actions and could control the process of achieving the goal. It was also found the correlation between levels of metacognitive processes. The most prominent were the correspondences of all metacognitive processes indicators with goal-setting \((r = 0.56; 0.52; 0.54)\). The correlations between modeling conditions of programming actions and self-control were less important \((r = 0.31; 0.40; 0.38)\). These correspondences show structural connections between the components of metacognition.

During the observations we found that children who put dialectical tasks constructed dialectical metamodels and programs of actions and monitored their activities more efficiently. They made cognitive actions sequentially: they chose the right book (guided by illustrations), asked to read, to observe or to experiment, asked clarifying questions. At the planning stage the sequencing of cognitive means was not called by children but the plan was identified while implementing. We offered the children who mentioned an experiment to hold it and they refused: "There is nothing here. We must prepare it first and then carry out". It shows children’s knowledge that the use of different means is a process including a series of actions: preparation, execution, fixing results. A child has a plan-model of activities in his / her mind but he / she does not consider it necessary for articulation. Formally-thinking children stopped their activity in the planning stage if they met any difficulties. It means that the informative self-control is impossible without development of all metacognitive processes.

4. Discussion

Our study confirms the results of other works in metacognitive psychology, and allows ascertaining some features of preschoolers’ metacognition.

The data indicate that the preschool age is start time to develop metacognitive structures, including metacognitive knowledge and processes.

The study allows us to conclude that in the preschool age metacognitive knowledge is associated with the generalization of cognitive experience. Because of undeveloped reflection and speech, children find it difficult to verbalize them. Children with dialectical thinking have them in the form of complex representations of cognitive activity as a dynamic system consisting of mutually exclusive characteristics. Such notions allow a child to be more efficient in self-regulation of this activity.

Our research shows that children can set formal and dialectical tasks at the same time. These tasks are aimed at knowledge of the specific properties of an object, its development and relations with surrounding objects.

Simulation conditions for attaining these goals by children is carried out by different types of thinking. Most cognitively active and dialectically thinking children pick out possible cognitive tools with regard to external and internal factors, the specific of problem situations, and therefore they can synthesize the most adequate metamodel for each specific problem.

There are children who think dialectically while programming the actions. That’s why they can make long-term and logical action programs, including the main stages of cognition and suggesting different options to achieve the goals. As a rule, these children carried out informative progress control.

Thereby, dialectical thinking in preschool age begins to perform not only cognitive but also metacognitive functions. Dialectical thinking enables the construction of metacognitive structures reflecting the cognitive activity as a dynamic system that gives the basis for efficient activity.

References


