

**LOGIC AND REASONING IN MATHEMATICS AND SCIENCE IN THE
PRESCHOOL EDUCATION**

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Abstract: In order to understand the cognitive development of the children in the preschool period we need to observe and try to understand the children – the things that engage and make sense to them, encourage them, their approach to the tasks, how they understand and solve them, how they perceive reality, the learning elements in which they are different, how they learn, whether it is on their own or with others. Several aspects are important for the cognitive development of the preschool children: logic, reasoning, mathematics and science. On the grounds of the theoretical and empirical observations, as well as the participative observation in the kindergarten, we distinguished several characteristics of the cognitive development of the children in the preschool period:

- ✓ The development of logic and reasoning is conditioned by the active position of the children in the learning process;
- ✓ The development is stimulated by discovery learning and problem solving;
- ✓ The children have inner motivation to learn about the world, the objects and the relations in it;
- ✓ The logic and reasoning of the children is conditioned by the possibility for their integration in different areas of cognition, including the mathematical and scientific ones;
- ✓ The cognition process depends on the sources and content of learning, which come from the everyday life of the children;
- ✓ Each child has an individual style and learning pace, as well as intellectual development.

In the school year 2015/2016 we carried out a quality research – participative observation of 2 kindergartens in Skopje. In this way we made a description of the characteristics of the cognitive development of the children in the preschool period in mathematics and science.

Keywords: cognitive development, logic, reasoning, mathematical area, scientific area.

Introduction

There are no priority domains in the children's development. It is carried out in a complementary way and the developmental domains are related. Hence, the progress a child makes in a certain domain, has a strong influence on the development and progress the child makes in another developmental domain. This is a proof that the children develop in a holistic way. By respecting the holistic approach in the educational process, we avoid the tendency to favor certain domains in the development of the personality of the child when setting the standards for early child development in the Republic of Macedonia. The same of attention is given to the following domains: physical health and motor development, socioemotional development, developing an approach to learning, language development, literacy and communication and cognitive development and acquiring general knowledge. It is necessary to highlight that the developmental process and learning of the youngest children is not carried out in an isolated way but rather continuously, through all the domains. The developmental domains are interconnected, and the children learn by building on the already acquired knowledge in all of the domains.

The development of the intellectual and mental abilities of the children is based on the cognitive development which, in the preschool period, is a dynamic progressive process which is the result of the interaction of the child with the objects, subjects, events, and phenomena which surround the child. One of the goals of the preschool education is to provide and support the cognitive development of every child, and, by doing this, help the child to learn about the surrounding world and develop ways of acting and experience new things. The logical thinking helps the children discover and learn about themselves, their needs and thoughts, which all together help the children develop intellectual independence and establish successful communication with the environment. The logical learning is integrated in the other developmental domains and it covers all the influences, actions and interactions which lead to the development of the general physical and logical-mathematical learning. Mathematics and science, as aspects of the cognitive development, develop logic and the abilities which allow the children to solve a variety of problems. The intellectual activity and the development of the cognitive abilities are crucial in this process.

Characteristics of the cognitive development of the preschool age children

The theoretical and empirical researches about the early child development and learning show that the children perceive and understand the surrounding world in different ways. The

researches carried out by Dakwort Eleonor provide information which can help us understand the nature of learning, as well as the nature of the mathematical and scientific reasoning of the children in the early child development. Based on many theoretical and empirical researches we distinguish the following characteristics of the cognitive development of the children in the early child development:

- ✓ the development of logic and reasoning is preconditioned by the active position of the child in the learning process;
- ✓ development is encouraged by discovery learning and problem solving;
- ✓ children have internal motivation for learning about the world, the objects and the relationships in it;
- ✓ logic and reasoning in children are conditioned by the possibility to integrate them in the different areas of learning, among which are mathematics and the natural sciences;
- ✓ the learning process depends on the sources of learning and the learning content which can be found in the everyday life of the children;
- ✓ each child has an individual leaning style and pace, as well as an intellectual development.

The described characteristics of the cognitive development are starting points for understanding the importance of these activities in the development of the elementary mathematical terms and the terms from the area of the natural sciences in the early child development.

- ✓ Active position of the children in the learning process

The logical-mathematical and natural scientific learning is best developed if the children are active in the learning process, i.e. if they learn through their own activities and actions. Children form mathematical and natural scientific knowledge through their own activity, not by listening about it. They acquire permanent knowledge through practical and active research of the properties of the objects, their shapes and quantities, dimensions and positions. In this aspect, the modern syllabi intended for early child development are structured on the basic principle for learning through problem solving and discovery.

- ✓ *Learning by discovery and problem solving*

Children develop logical-mathematical and natural scientific knowledge through learning by discovery and problem solving. Children must construct knowledge independently

and this is characteristic of the development of the intellectual processes. Children must be given opportunities to solve problems in the educational process, and they should do this by exclusively relying on their own abilities and activities. In these processes, the children use their previous experience, they develop strategies, observe, notice and make efforts to solve the problems. They test their hypotheses through practical and intellectual activities. In this way they develop knowledge that is the result of the internal struggle of the child with the problem.

✓ *The internal motivation and the learning process*

Children are internally motivated to learn about the world, the objects and the quantitative relations in it. They constantly ask questions and seek answers. The internal motivation of the children for learning is more important than the external. This highlights the need to solve problems, conflict situations, to realize personal goals and theories and define the surrounding world. These are the most important impulses in the learning process of the children. Starting from their own needs, the children explain to themselves why day and night occur, why certain objects have particular shapes, what the purpose of the numbers is, etc. The internal motivation to understand the surrounding world can be supported by creating conditions for activities that will encourage the children to explore, learn and discover. The basic precondition is for them to be given an opportunity to present and resolve their own ideas and to receive support in finding solutions.

✓ *Integrating mathematical and natural scientific knowledge*

Learning and instruction cannot appear with a subject structure and in a way which is logical only to adults. There needs to be a psychological order, typical for the characteristics of the reasoning of the children. In the early child development, children cannot learn certain areas such as language, mathematics, nature. The mathematical terms and the terms from the natural-scientific area make sense only if they are integrated into the general activities, during which the children solve problems from everyday life, such as projects, solving problems or learning about specific topics. If the educational work is focused on the subject areas, the effects will be isolated skills and content, which does not result in forming new terms. Every activity that promotes the development of a single area, influences other areas as well. According to this, by doing physical activities, the children also learn about orientation in space, they mention the mathematical terms or the natural-scientific ones when they talk about certain events, etc. It is not typical for the children to offer activities which encourage

only drawing, mathematics or other areas. This type of work results in isolated, abstract information which render the understanding of mathematics and natural sciences more difficult and at the same time, it decreases the potentials for using this knowledge in a different context. The integrated learning in the earliest period of the development of the children allows relating terms with other aspects of learning, which is realized in a most natural way in the practical situations from the everyday life of the children.

✓ *The learning process depends on the sources of learning and the content*

The successful discovery and forming of the logical-mathematical and natural-scientific learning depends on the sources of learning and the content, which come from the environment where the children live, and from an abstract source. The experiences from everyday practice, many researches and a directed qualitative research show that the cognitive development of the children, based on instructional activities outside the context, render the process more difficult and uninteresting. These activities are not understandable for the children and render the generalization and use of knowledge more difficult.

The experience from using the syllabus Rego-Emilija, which treats the kindergarten as an authentic context where the life and relationships of many children and adults occur, is positive. The context of the kindergarten is treated as a web of relationships and influences, and all the factors in the kindergarten form a specific learning situation. Taking into consideration that the mathematical and natural-scientific concepts are a natural part of the life in the kindergarten, the different concepts in it are sufficient for the basic mathematical and natural-scientific education of the children.

Terhart says that the timetable and the organization of the space should be adjusted to the needs of the children. He adds that they should be organized in such a way so as to allow the children to learn in a live context about the events in the kindergarten (Terhart, 2001).

Accordingly, the appropriate time and space for learning and understanding the mathematical and natural-scientific terms is the time and space when these situations occur. For example when the toys are in different corners, when the objects are placed in certain places, the time of eating snacks, etc.

✓ *The individualized style and the pace of cognitive development*

Each child has an individual learning style and a pace of cognitive development, i.e. each child is a person with experience, attitudes, skills, learning styles, and levels of development of the intellectual abilities. In order to improve the effect of the educational

work, we must take into consideration the pace of development of the logical-mathematical and the natural-scientific learning of each child.

The learning style shows the way in which the children receive information, how they organize information and build knowledge. The children in early development have different approaches to solving tasks. The research showed that the younger children see the practical side of the tasks, while the older children distinguish rules and discover problems.

In the learning process, children react with emotions. Knowledge is mixed with emotions which renders the interpretation of the children subjective, which can also be characteristic of older children. They choose a certain object because they like it, or a way to solve a task because it reminds them of something familiar.

Conclusion

Our visits in the preschool institutions Orce Nikolov and Majski Cvet in Skopje, as organizers and participants in the qualitative research – participative observation allowed us to describe the characteristics of the cognitive development of the preschool age children related to mathematics and science. This participative observation of the educational activities in the large groups in the mentioned institutions allowed us to directly gather qualitative data which confirmed our theoretical findings regarding the matter of this paper.

At the same time, this research led us to the following conclusions:

1. In the educational practice, the development of logic and reasoning is conditioned by the possibilities for the child to be active in the process of learning and creating;
2. The cognitive development is conditioned by the encouragement of the children in the learning process and the use of models for active learning, such as discovery learning and problem solving;
3. The internal motivation for learning about the world, the objects and relations in it is the most important impulse in the learning process of the young children;
4. The development of the logic and the reasoning of the children is determined by the possibilities to integrate different areas of learning, including mathematics and science;
5. The process of learning in the mathematical and scientific area depends on the sources and the content, which are the result from the content of the everyday life of the children;
6. In order to improve the effect of the educational work, we should take into consideration the pace of development of the logical-mathematical and the natural-scientific leaning capabilities of each child.

Recommendations and suggestions

The described characteristics of the cognitive development are starting points in the organization of the educational work in the early child development. According to this, when creating conditions and instructional practices, the educators should:

- adapt the procedures and activities to the goals and programs for early child development;
- plan the activities in a way that will allow an active position of the child in the learning process;
- respect the internal need of the children to learn and develop and use it as an impulse to determine the work in general;
- apply integrated and contextual learning adapted to the individual learning style and pace of each child.

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