# Teaching Methodology of Mathematics

Metodika 18 (1/2009), 290-303
Professional paper
Paper submitted: 30th January 2009

# THEORETICAL FRAMEWORK FOR THE DEVELOPMENT OF MATHEMATICAL CONCEPTS IN KINDERGARTEN

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***Summary -*** *The development of mathematical concepts at preschool age presents a powerful tool for developing not only children's cognitive development but the development of all other personality aspects. The realization of developmental goals and tasks in the contemporary preschool curriculum, from the aspect of developing mathematical concepts, demands good knowledge of the nature of child development, the manner in which children learn and the nature of each mathematical concept which is formed at this stage. This article will refer to the basic characteristics of children's cognitive development in the function of developing mathematical concepts and characteristics of learning of a preschool child. Pedagogical implications by renowned psychologists and education experts relating to preschool education have been emphasized. Based on these implications, methodological guidelines were set up and serve as important coordinates in the practical work of the preschool teacher. The part referring to characteristics of learning of a preschool child accentuates the importance of practical and thoughtful engagement of a child in the process of learning, learning as construction of knowledge and experience, learning as investigation, learning in interaction with adults, peers, ideas and materials, necessity of verbalization in the process of learning and encouragement of meta-zone learning which small children are capable of. In the part referring to methodological guidelines, importance is given to situational learning, integrated planning, the creation of a motivational learning environment, observation and monitoring of children in the learning process so as to ensure progress and developmental appropriateness, which is especially evident in the process of developing mathematical concepts.*

***Key words****: development of mathematical concepts, preschool child, cognitive development, child learning, methodological guidelines*

## INTRODUCTION

The opinion about the importance of mathematical education at an early age seems to be undivided today. Mathematical content permeates children's activities and games. Understanding quantitative relationships, understanding the concept of area and spatial relations, observing shapes and dimensions of objects, use of various principles of measuring etc. are becoming a basic condition for engaging in practical work at this developmental age. Mathematics introduces a child into the world of perception and understanding of relationships in its immediate surroundings, helps the development of thought and other physical functions and also enriches a child's vocabulary necessary for good and clear communication in its environment.

When starting preschool, the logical-mathematical development acquires characteristics of planned and systematic work in accordance with the demands of the modern, integrated preschool curriculum. It encompasses the following mathematical areas: observation, understanding and abstracting space and spatial relations, observation, naming and abstracting object dimensions; developing the concept of geometric shapes in space and in plane; developing the concept of number based on logical operations with concrete objects and operations with sets and measuring activities.

The theoretical framework for the development of mathematical concepts in an integrated preschool curriculum has the function of general orientation in work taking into consideration developmental characteristics of a preschool child, its learning characteristics, the nature of mathematical content, and the application of particular methodological guidelines which have as an aim successful actualization of developmental tasks at the preschool level. Methodology of developing initial mathematical concepts is an interdisciplinary founded area which relies on scientific knowledge coming from preschool pedagogy, developmental psychology, mathematics, didactics, preschool methodology, psychology of knowledge, logic and sociology. Due to its high level of abstraction, characteristics of mathematical concepts as well as the age and development of a child, the methodology of developing mathematical concepts is especially familiar with theoretical and empirical results of research in developmental psychology. In theoretical approaches and educational practice there is an undivided opinion that the development of initial mathematical concepts should follow, i.e. be in harmony with:

- Developmental characteristics of preschool children, i.e., the nature of that development, primarily the nature of their cognitive development and
- Characteristics of the learning process of a preschool child.

This knowledge is the foundation of basic methodological directions which ensure successful realization of educational outcomes in developing initial mathematical concepts with preschool children within the framework of institutional preschool education.

# BASIC CHARACTERISTICS OF CHILDREN'S COGNITIVE DEVELOPMENT IN THE ROLE OF DEVELOPING MATHEMATICAL CONCEPTS

A preschool child is characterized by the particularities of the developmental process especially in the area of cognitive development. Mathematical content is abstract by nature. However, in order to avoid high abstraction and to make these processes follow the natural child development, it is necessary to have knowledge of that development. Many psychologists researched children's cognitive development and the results of their research make an inevitable starting point in finding a methodological approach for the development of mathematical concepts. Some of the most important observations relevant from the methodology point of view in the process of developing mathematical concepts will be elaborated.

Many psychologists, among whom the most influential were Piaget, Vygotsky, Bruner, the psychologists of the so called Moscow school who have continued Vygotsky's research: Zaporozac, Elkonin, Galperin, Leontyev, and others, provided great contributions to understanding children's cognitive development. Although the majority of these psychologists worked and researched in another time period and in different social circumstances, many of their findings are applied today and are part of many other systems of knowledge when referring to preschool children. Their scientific contributions are an inevitable source of all interpretations of children's development or are starting points for new scientific research. The results of their research present a challenge for today's new generation of psychologists in the sense of confirming or disproving previous research results and developing new theories based on previous ones. The reception of learning by Piaget, Vygotsky, Bruner and others found its place in books of many contemporary authors throughout the world (Donaldson; Wood; Medouz-Kešdan; Bredekamp; Vasta; Haith; Miler et al.). Furthermore, work by authors in former Yugoslavia who have examined and interpreted results of the great psychologists on a population of children in this region are important from the aspect of their integration into methodological foundations based on which our teaching practice[1] relies on.

Surely, one of the world's most famous psychologists-epistemologists is *Jean Piaget* (1896-1980). The essence of his biologist theory lies in the statement that learning is subordinated to a child's developmental process, that it depends on the level of development and that the influence of maturation is elementary for development. The pre-operational stage (in Piaget's periodisation of a child's cognitive development) occurs between the child's second and sixth year of life. The basic characteristic of the pre-operational stage is the so called situational intelligence. During this period a child is under strong influences of

[1] Refers to the research by I. Ivića, E. Kamenov, L. Horvat, N. Gajanović, I. Toličić, M. Jovičić, M. Pešić as well as the work of A. Marjanović, Čudina-Obradović. M, Vizek V., I. Furlan and others.

the visual reality and its thought is "entrapped" in perceptive mechanisms[2]. A child at this age understands only those quantitative and spatial relations which are perceptive. However, knowledge is not a mere copy of reality, it is more. An individual must transform those objects in a particular way at the cognitive level in order to acquire knowledge about those objects. From this point of view, and from the point of view of child's cognitive egocentrism, Piaget points out that the preschool period is marked by the absence of *conservation*, *reversibility*, *seriation* and *inclusion*. Piaget also stresses the importance of speech and believes that in the pre-operational phase of speech "they make plays, there is an interiorizing of material operations (what was external, active and concrete gradually becomes internal, symbolic, i.e. mental)" (Prentović-Sotirović, 1998, p. 77).

Although a number of authors dedicated their scientific work to explaining and examining pedagogical implications of Piaget's theory in educational practice, one of the most famous was Constance Kami[3]. There were authors who believed that Piaget does not give the preschool teacher any kind of a status in the education of children. "A child learns by activating its sensory system, sharpening it and by using intelligence." Gradually, the physical, motor and sensory system becomes replaced by mental activities in the form of symbolic and mental operations. The role of the grown-up in this development remains undefined" (Beler, 1979).

Although Piaget's theory received and continues to receive certain criticism, the fact that his theory had and still has important pedagogical implications cannot be overlooked. Those positive implications for the development of initial mathematical concepts are the following: (Prentović-Sotirović, 1998., pp. 79-81; Kami, 1971, pp. 406-415).

- A child's learning is a continuous process of constructing knowledge, where a child's own activity plays an indispensable role (in this process we cannot talk about knowledge transfer, but active acquisition of knowledge through practical-manipulative and other activities which will be found in the basis of active mental constructions);
- A child must be allowed to learn in its own way;

[2] Piaget's research has been subject of a lot of testing and criticism, by his contemporaries as well as new researchers. Vygotsky, Bruner, Galjperin and many others, who have emphasized the importance Piaget had on developing cognitive psychology, also questioned some of his results, contested some of his research and highlighted them from another aspect. Margaret Donaldson's book "Children's Minds" and the book by David Wood "How Children think and learn", presents a significant contribution to those discussions.

[3] Constance Kami is a teacher of early childhood education at the University of Alabama, USA; She was the first to develop the program for preschool education based on Piaget's theories. She has conducted numerous research and published many books in the area of methodology of development of numbers at an early age. A number of her articles have been translated in earlier editions of the journal „Predškolsko dete".

- The learning of a preschooler must be in accordance with the level of its cognitive development; focus should be on the development of general cognitive organization and not only specific skills;
- Although the cognitive development process has a particular sequence, individual characteristics of each child cannot be overlooked, since each child has a particular developmental rhythm;
- In the learning process, children should be enabled to acquire more self-confidence in the way they perceive objects, that they rely more on their own thinking processes instead of learning by conforming;
- Logical-mathematical structures are developed in a particular sequence which is necessary to know and support in the process of learning at an early age; in order to reach a particular stage of development, particular steps must be acquired since the following stage is founded on them;
- It is important to demand that children express their thoughts and verbalize their experience; children should be allowed to express themselves freely;
- The role of the preschool teacher is not to transfer ready knowledge but to help a child develop it own knowledge in the way that the teacher will guide its experience.

*Jerome Bruner* (1915 – ) today's greatest psychologist shares Piaget's opinion on cognition as the active construction of the subject. However, he opposes the biological understanding of development and believes that there is no internal learning stimulator without an external stimulus (Prentović-Sotirović, 1998, pp. 81-86; Bruner, 2000). Bruner sees relevant "intensifiers" of the learning process in social subjects, the family and educational institutions. In that way his theory is much closer to the studies of Lev Vygotsky. Explaining the three phases of modes of representation: enactive; iconic and symbolic, Bruner emphasizes that the representation of objects in the thought is inseparable from a child's action in relation to that object, while the word is the highest level of reality representation. The author gives special attention to speech believing that words ease the development of concepts since *stabilization of concepts demands its verbal support*. (Manojlović-Arsić, according to Prentović-Sotirović, 1998, p. 83) As opposed to Piaget, Bruner placed more emphasis on researching educational systems and their influence on children's development. The most important pedagogical implications in his studies are also important from the aspect of developing mathematical concepts at an early age: (Prentović-Sotirović, 1998, pp. 84-86; Wood , 1995, Stojaković, 1981)

- Early education has a positive effect on child development and it must be adapted to the stages of a child's development in a manners which is both interesting and appropriate;

- Learning is more purposeful, interesting and successful if it stems from the subject's internal motivation;
- Cognitive operations which are primary in developmental stages in which a child is and which will enable further cognitive growth;
- Children are capable of understanding a lot of knowledge if they are exposed to them in a meaningful and appropriate manner;
- Cognitive development must be based on active construction of knowledge;
- More attention should be given to learning general principles and ideas and transfer of instruction;
- Learning and communication are by nature inseparable; speech has a indispensable role in a child's cognitive development;
- Teaching and communication, and joint work of children and adults have an important value in the process of learning and problem solving.

*Lev Vygotsky* (1896 – 1934) is the most famous Russian psychologist whose work was continued by generations of Russian psychologists. Over the last thirst years his work was subject of research and interpretations of almost all western psychologists. He is the creator of the socio-cultural theory which emphasizes that higher mental functions are of a social origin. According to his theory higher mental functions are of a social origin and are determined by facts such as: common practical activities, social interaction, symbol system (primarily speech, script, etc.) and communication through those symbols (Prentović-Sotirović, 1998, p. 86). Lower mental functions are natural, and higher mental functions are a result of cultural development. Great significance is given to quality communication among participants in the educational process, believing it to be one of the basic factors and drives of mental development. Encouragement of the "next phase of development" presents a key moment in his theory of development and its practical application. Research shows that the "*zone of proximal development has a direct impact on the dynamics of intellectual development and success than the current level of their development*" (Vygotsky, 1983., p. 254.) A child's cognitive development is analyzed through the following developmental stages: syncretic thought; complex thought; phase of potential concepts (presence of cognitive processes of analysis and abstraction) and development of real concepts (ibid., pp. 132-182).

Vygotsky stresses that early development is very complex and that various forms of thought do not occur successively but that many occur parallel to each other. The pedagogical implications of his theory of child development which are significant from the aspect of educating small children would be the following: (Vygotsky, 1983, pp. 252-260.; Prentović-Sotirović, 1998, pp. 93-94.)

- Education of a preschool child must be different from the education of a school-aged child;

- In the process of child development it is necessary to take into consideration developmental levels of a child's cognitive ability;
- Learning should precede development;
- In cooperation a child can always do more than independently, however only to a certain extent, that is strictly defined by a child's development and its intellectual abilities;
- When cooperating, a child can more easily solve tasks which are at its developmental leave; what a child can do today in cooperation, is what it will be able to do tomorrow independently;
- The functional use of language should be encouraged by motivating a child to verbalize actions, relations, etc.
- A child's development should take place during play time or practical activities, and the role of the preschool teacher is to organize and arrange the environment and to promote such influence which will motivate and maintain a child's activity.

A significant contribution to understanding child development was given by psychologists of the Moscow school with its numerous empirical research. ***Galperin*** and his associates emphasized the possibility of a child's faster development of cognitive structures under the influence of systematic and planned work within the institutional framework of preschool education. Their studies were based on criticism of the Geneva school with its model of stages of formation of cognitive tasks which prove that development depends on the learning process. Their research in the area of developing mathematical concepts in preschool children claims that it is possible to develop those concepts even at an earlier age using an appropriate approach and by guiding children in the process than through spontaneous child development.

It can be concluded that the mentioned psychologists share a unique attitude when referring to the issue cognitive development of a preschool child:

- ❖ A child's development at an early (preschool) age is marked by particular traits as opposed to a child of school-going age and an adult, and
- ❖ Each phase of a child's development presents a base for future phases of development.

In that sense Piaget talks about physical awareness as a precondition to developing logical-mathematical awareness; Bruner refers to the active phase as a base for higher levels of representation reality; Vygotsky emphasizes the importance of a child's practical, and especially social experience in that process; Zaporozac and Elkonjin stress that verbal-conceptual thought precedes the sensory-presentational thought. Based on this knowledge, a basic *methodological way* for developing mathematical concepts was developed. It can be expressed in the manner of Liebeck P. (1995, p.11): **I** – experience of physical objects **G** – spoken language which describes that experience; **S** – images which show that experience and **Z** – written symbols which generalize that experience.

A methodological approach in such an order is in accordance with understanding mutual relationships of the physical and logical-mathematical awareness and the relationships of the social and logical-mathematical relationship. Therefore, what is common to all authors/psychologists is the emphasis that all mathematical concepts are "built" on items, objects and occurrences of the real world bringing them into connections at the mental level, with the aid of symbolic structures such as speech and other written symbols. This is an important methodological stronghold for the development of mathematical concepts which claims that one's immediate environment, not only the immediate physical environment, but a child's social environment is indispensable in the process of developing logical-mathematical structures.

## BASIC LEARNING CHARACTERISTICS OF A PRESCHOOL CHILD

In addition to knowing and accepting characteristics of a child's cognitive development, it is necessary to know certain learning characteristic of a preschool child in order to successfully teach and develop mathematical concepts. There exist various definitions of learning, but many of them fail to reflect the complexity of learning of a preschool child. In that sense, the definitions by E. Kamenova and A. Marjanović seem to be most appropriate. Kamenov, among other, defines preschool learning as a process of refinement and shaping of experience, recognition and discovery, observation into the essence of concepts, reconstruction of already known awareness and establishing knowledge associations. (Kamenov, 1999, book p. 21). Marjanović believes that a preschool child's learning should be seen as "a way in which the chaos of impressions is attempting to find order and to isolate independent and thought units". "Education therefore, would not be a process of providing answers and explanations, but offering tools through which a child can, at first in a simple way, and then more complex way, arrange its experience, judge the experience and acquire new experience on a more organized level" (Marjanović, 1971, p. 446).

At an early age, the learning process is dominated by ***sensory and motor experience*** which precedes symbolic learning at higher levels and serves as a basis. Learning of a preschool child demands complete ***practical and cognitive activity of a child***, which is also a basic condition in the formation of mathematical concepts. This leads to the conclusion that the basic characteristic of a preschool child is internalization of practical actions on the inner, cognitive plan. In accordance with that, A. Marjanović emphasizes that education at a preschool age "… has to ensure that motor and functional activities gradually transform into symbolic, that a child's play transfers onto the intellectual plan, becomes formalized and cultivated." (1971, p. 445.) Methodological implications of this awareness at the level of developing mathematical concepts is reflected in the

demand that mathematical concepts cannot be "taught", "transferred" onto the children, but that a child must develop them, construe them in numerous contacts with items, objects and appearances of immediate reality.

Everything that has earlier been said on the cognitive development of children and learning characteristics are most closely related to the ***constructivist*** manner of learning of a preschool child. *The essence of the constructivist approach to learning is in the interaction of a child's experience with materials, ideas and people*. The constructivist theoretical concept emphasizes the building of understanding of the world based on ***personal experience*** and *background knowledge* which makes the process of learning unique for each individual. All new knowledge and experience of a child is based on its background knowledge and makes up a constructive element of new knowledge structures. The emphasis is on acquiring first hand knowledge, on the active role of the subject in developing knowledge and understanding reality. „The thread of creating meaning which permeates numerous activities and various experiences of a child, enable a child to understand the relationship between past and present events, between people, objects and events in this world" (Barbour & Seefeld, according to Slunjski, 2001, p. 49).

Appropriate practice which takes into consideration and has as its starting point the advantages of the constructivist approach in the learning process emphasizes learning as a *research act* in which a child learns through research in interaction with adults, other children and materials; where children are active both physically and mentally in concrete activities relevant for their life experience and in which children learn through problem-solving and experimenting. The process of learning initial mathematical concepts occurs in the same manner.

In that sense, Seefeldt C., Barbour N, (1994, p. 454), point to the attitude of the National Research Council, from 1989, that mathematics cannot be taught but math can be learned only when children *construct their own mathematical understanding*.

Although the idea of ***cooperative learning*** (co-construction of knowledge) is nothing new, it has become a current and inevitable issue in discussions on modern preschool education. The modern attitude on the learning of a preschool child emphasizes the importance of cooperative learning from the aspect of developing knowledge in social interaction in which the learning process takes place in mutual peer activities based on discussions, debates, cooperation and agreement which is focused on the common goal. Bruner dedicated a lot of his research to the influence of cooperative learning, supporting the idea that acquisition of knowledge and peer communication is by nature interdependent and inseparable. In emphasizing the importance of interaction with others, he believes that they can serve each other as "*scaffolds*". He sees the aim of education, in among other, the development of good cooperation with others. "In the cultural-psychological approach to education, a classroom would be a community of mutually helping students, and a teacher would be a type of conductor". (Bruner, 2000 pp. 34-35).

Numerous authors point to the basic merit of cooperative learning which is understood as a type of social learning where *group discussions, agreements, negotiations, and mutual cooperation takes place*. ***The exchange of ideas with other children*** can help a child question his/her own ideas. „For that reason, confronting peers is of crucial importance in the development of logical-mathematical knowledge" (Kami 1992, p. 41). Cooperative learning, learning in interaction with peers and adults is a dominant way of teaching little children and contemporary methodological approaches give it a lot of importance.

Such a manner of cooperation among children, in bigger and smaller groups, the authors stress, is especially evident in the process of problem solving, i.e. the ability to view a problem from various aspects and based on that reach some conclusions. Furthermore, cooperation improves relationships among children in a group, encourages self-confidence of each individual in an environment where there are no right or wrong answers and where everyone's opinion is accepted.

In describing and explaining their experiences, procedures, results, etc through play or other activities the ***importance of words*** becomes crucial in developing concepts and thought in general. Using speech, a child's thought becomes clearer and more operational, practical work is transferred to the thinking process and *internalization* occurs much faster. Speech plays a big role in the transfer of practical to thoughtful presentation of reality. "When an action has to be thoughtfully acquired can be accurately verbally expressed, the process of its transfer into the thinking area is initiated" (Dobrić, according to Prentović-Sotirović, 1998 p. 110). This is especially evident in the area of developing mathematical concepts. In addition to the demand that complete practical and thinking activity of a child is ensured there is the demand of continuous ***encouraging of a child's verbal activity***. If a child verbalizes its experience, the teacher will receive important feedback on the level of development of particular mathematical concept which sets the starting point in the process of planning further work.

Bruner believes that "desire for learning" is based on four motifs: *the curiosity motif; the competence motif; the identification motif and motif of mutual cooperation* (according to Stojaković,1981, p. 61). These four motifs can be recognized in the learning process of a preschool child. A child is by nature a very active being and that activity is the result of another important characteristic, ***curiosity***. The development of initial mathematical concepts has a stronghold in that characteristic of a child's learning and development, and alongside with the motif of curiosity other related learning motifs are strengthened and realized. The competence motif is important at this age. A child wants to reach the ability to do what others can do, independently. This motif is a strong motivator of a child's aspiration to reach the level of an effective and competent mutual effect on the environment (Stojaković, 1981 p.17). M. Pešić stresses the importance of internal motivation which stems from functional needs such as the need for feeling competent. "Intrinsic motivation can broadly be defined as the system of *psychological regulations of activities*" (Pešić, 1985, p.117).

The best way to encourage intrinsic motivation of a child for learning, where in addition to the motif of competence other motifs for learning will be encouraged are ***problem situations and learning through problem solving***, which is considered an important methodological approach in the area of developing mathematical concepts.

The contemporary approach to preschool education emphasizes another ability of a preschool child in the learning process and that is ***metacognition***, i.e. being aware of one's own cognitive processes, ability to self-reflect and self-evaluate oneself in the process of learning. Some authors refer to this ability as *thinking about thinking*. (Seefeldt., Barbour, 1994, p 458). Bruner emphasizes that modern pedagogy is coming closer to the viewpoint that a child should be aware of its own thought processes and that it is important for pedagogical theoreticians and teachers to help children/students to become metacognitive – to become aware of how they are learning and thinking while acquiring teaching content. It is not enough to acquire the skill and pile up knowledge (Bruner, 2000 p. 75). Metacognition includes the awareness of whether something was understood or not, as well as whether someone remembers something in a given moment or not. "Metacognition is made up of knowing personal abilities, as well as the ability to assess whether a task can be completed or not. Finally, what is most important, metacognition implies having the ability to manage one's knowledge" (Medouz and Kešdan, 2000 p. 81).

A preschool teacher is the one who, through clever questions and indirect manners of teaching, helps children gain insight into the process of awareness which they pass while learning and problem solving. The teacher helps children gain control of their success or failure and take necessary steps in the further process, and to enter, as Bruner says, the meta-zone.

## METHODOLOGICAL GUIDELINES IN THE PROCESS OF DEVELOPING MATHEMATICAL CONCEPTS

In addition to knowledge of cognitive development and learning characteristics of preschool teachers, the methodology of teaching mathematical concepts should also take into consideration knowledge and awareness of particular methodological principles which will help achieve the developmental goals and aims in the area of their cognitive development through mathematical concepts. In this paper we will refer to some methodological guidelines which are important from the point of view of this topic area, in addition to all others where aspects referred to in didactic and methodology literature.

Contemporary authors emphasize the importance of considering a ***child's life experience***, which is at the same time an important methodological guideline. This implies the need to manage situations and events from a child's everyday life in the selection of content, i.e., that mathematical content be related to a child's

own experience and real life problems it encounters. This is in line with situational learning or so called experiential mathematics (contextual mathematics) (Seefeldt C., Barbour 1994; Prentović-Sotirović, 1998, Andrews, A., G. & Trafton,P.,R., 2002). Such mathematics is not only more interesting to children, but more logical and it seems that it is carried out with pleasure. That is why the teacher needs to know the current interests that children have and based on them develop mathematical concepts. As Frederik and Papy state, modern mathematics is mathematics of basic practical life actions (1972, p. 39).

C. Kami (1992 p. 27 – 45) emphasizes that everyday surroundings can do a lot in an indirect way. It can speed up the development of logical-mathematical awareness, and "…indirect teaching can vary from encouragement of children to match all types of items into all possible relations, to asking a child to set the table with enough plates for all the children." It is necessary to encourage children to relate objects, events and happenings in everyday life into all possible types of relations. "Children, who think actively in everyday life, think of several things at the same time. Mathematical concepts are created by children in everyday life if they are encouraged to think" (ibid, p. 28).

The importance of multiple relationships in a child's everyday life is the subject which other authors write about, among others, Hejny Milan who says that "The degree of understanding a concept is determined by the degree of relationship between personal experience and direct knowledge and other concepts and ideas in thought. If the relationships are multiple we link them into logical knowledge" (2004, p. 15).

In that respect, planning based on principles of an integrated curriculum presents a good framework and ensures the application of mentioned methodological guidelines in the best way possible.

Relating to this there is a need for arranging conditions which will help a child to organize knowledge and experience, reason about them actively and use them in everyday activities. Only in natural, everyday situations will mathematical content *make sense to a child* and help a child understand the importance of using mathematical procedures in everyday life situations. „Acquiring information in a thoughtful context is not only important for a child's understanding and development of conceptual thinking, but also for encouraging a child's motivation. If learning is meaningful to children, they will persevere in the task and will be motivated for further learning" (Bredekamp, 1996 p. 65). Frederik and Papy also say that it is "amazing how little children deduce correctly in situations they are familiar with and if they are interested in them as well as how their thought is based on a structured sensory stronghold" (1972, p. 38). Finding such situations requires good knowledge of child development, knowledge about how a child learns and the nature of each mathematical concept.

***Trying to avoid forcing a child to provide the correct answer*** and continuous error correction is also an important methodological guideline for teaching young

children. Instead, it is necessary to encourage children's understanding of ideas. „If we "send across the message" that adults are the only valid source of experience, we inadvertently teach them that the truth can only come from us. A child then learns signs of approval or disapproval from the teachers' facial expressions. In this way the dependency on another's opinion child becomes stronger for the child and results in learning under an adult person's influence"(Kami, 1992, p. 40). Contemporary research emphasizes the crucial role of the preschool teacher in encouraging independence in acting and thinking in a child. A very negative influence of the authoritative adult on a child's development is not only reflected on the socio-emotional plan, development of self-image abut also has a negative effect on a child's cognitive development. It is believed that child/children who are educated in an autocratic environment have fewer chances for developing logical reasoning which is the basis for developing mathematical concepts.

Knowing the nature of mathematical concepts, the principle of gradualism seems to be imposing. Mathematical concepts cannot be developed "by skipping", they also have a very strict internal structure in which each concept or procedure stands as the basis for developing the following concepts and is a precondition for further understanding and use in activities, games and speech of a small child.

Gradualism in work and acceptance of developmental appropriateness are intertwined in everyday activities. In accordance with that, and in addition to knowing the nature of each mathematical concept, its methodological application, the nature of a child's development, it is expected that a preschool teacher also has a developed ability of ***observing and assessing children*** in everyday activities. That will help them recognize the developmental moment in which a child is standing and to evaluate the level of development of each mathematical concept in a child. The decision on taking the following step in the educational process depends on those abilities.

The contemporary approach in the development of mathematical concepts presupposes the creation of an ***encouraging, stimulating environment*****,** creation of a motivating learning context and ensuring a large number of various sources of learning which will help a child to independently, using practical-manipulatives and other games and activities discover mathematics. In addition to objects from everyday life and didactically structured materials, various picture-graphic materials in which quantitative relations are presented through symbols and signs also have an important role.

We can conclude that the area of developing initial mathematical concepts in preschool institutions demands a high degree of professional competence of teachers in the area of preschool pedagogy, developmental psychology, the nature of particular mathematical concepts and many other disciplines which are central to the issues of educating children. A teacher must continually strengthen professional competences so as to feel autonomous in the work. A teacher should consciously set priorities in relation to what should be achieved with children

and with what is the goal, in this case the area of developing initial mathematical concepts but also in all other areas of development.

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*Translation from Croatian: Ivana Cindrić*