JOURNAL OF EDUCATIONAL SCIENCES THEORY AND PRACTICE Vol. 16, No 2, 2021

Received: 28,10.2021
DOI: 10.46763/JESPT21162047a
UDC: 373.3.02:51(497.4)
Revised: 28.11, 2021.
Accepted: 03.12.2021

DEVELOPMENT OF BASIC MATHEMATICAL CONCEPTS - SENSE OF COUNTING

Igorcho Angelov

Primary School Hinko Smrekar, Ljubljana, R. Slovenia
igorcho.angelov@guest.arnes.si

Abstract. We live in a time of transition when so many things in life change very quickly. Therefore, adults and especially young children are exposed to various changes that sometimes positively or negatively affect our and their psychophysical and social development, regardless of the circumstances in which we find ourselves. Very fast changes also lead to a change in the entire economic system. They are even more pronounced in the educational system. Suddenly changes are happening all the time and they are felt in the kindergarten, which nowadays represents not only worries, but also a new beginning of children's learning, as children in the kindergarten get to know each other and then they get to know different learning contents in different areas. They learn to live and develop both mentally and socially. The whole development, however, continues and is upgraded in primary school, when children familiarize with a new environment, people, friends, new ways, and changes that lead to the building of their personality. Based on this, we can say that at this time we are currently living in the time of Covid 19, when we have a state of emergency due to a pandemic; people are even trying to build a new life system, develop our new personalities and develop a new educational system. From this context, we decided to write a paper, the purpose of which is to show the upgrade and easier acquisition of new knowledge in mathematics. In this article, we present some theoretical starting points as well as practical activities that need to be carried out in kindergarten and in the 1st triad of primary school for children to start with mathematics from an early age and fall in love with it.

Key words: numbers, counting, didactic games, mathematical concepts

1. INTRODUCTION

For Math we can say that it belongs in natural sciences. It is all around us. The very thought of mathematics does not mean details or a fact that presents them to us in life, but for knowledge of mathematical concepts through play and various activities through which professionals in education, we present the basics that will help children develop mathematical knowledge in the online school too. Children learn basic mathematical elements already in kindergarten and in the 1st and 2nd triad of primary school with various didactic games.

It is very important that we, professionals, have a large selection of different learning methods, techniques, and forms of work to present and adapt knowledge to children according to their age and to be able to achieve the set mathematical goals.

In the early psychological development or in the phase of cognitive and speech development in middle and late childhood, children learn many didactic educational games much faster than later. So, it is important that to children at this stage mathematical knowledge is presented in the easiest way with the help of various teaching aids and games. We can say that children count and use numbers very early, which does not confirm that children know how to count.

Professionals sometimes encounter various problems with the selection of teaching aids and games, as there is a great shortage of them. However, we can say that anyone who wants to be a solidary, creative, and professional worker can make and prepare both didactic games and didactic accessories.

The purpose of this paper is to show the basic elements of teaching mathematics from an early age using didactic games and accessories.

The aims of the selections of mathematical contents are to show games with which professionals could more easily show children how to understand numbers and mathematical operations at an early age.

2. Theoretical bases

In the curriculum for kindergartens and the curriculum for primary school, mathematics is described as one of the independent areas of activity for working with children in kindergarten. Mathematics, however, is intertwined with all other fields, namely language, art, society, music, nature.

Therefore, mathematics is involved in various activities in kindergarten and primary school, which encourages children to gain experience, skills, and knowledge in games or daily tasks, which they then use in future development. Thus, children begin to use the acquired experience and knowledge more effectively if they only use mathematical strategies and principles. Regardless of whether the children will achieve and successfully solve the problems, they try to find new solutions and adjustments that come to the solution and confirm the way and direction they use in finding the exact solution (Kurikulum za vrtce, 2007 and Žakelj A., 2011).

In the kindergarten curriculum and in the primary school curriculum, the objectives are divided into two groups, namely global and general objectives. Global goals are related to counting and addition and these are: learning about mathematics in everyday life, developing mathematical expression, developing mathematical thinking, developing mathematical skills, experiencing mathematics as a pleasant experience (Kurikulum za vrtce, 2007 and Žakelj A., 2011).

General objectives are related to counting - children are using names for numbers, they understand individual objects and gradually move to counting and distinguishing between a number and a numerator, perceive adaptation and know how to adapt, and learn about differences in measurement and counting measures (Kurikulum za vrtce, 2007 and Žakelj A., 2011).

2.1. Planning and day-to-day activities

There are also important daily activities in the kindergarten curriculum that education professionals must use for counting with children aged three to six, as well as further in the first triad, namely (Kurikulum za vrtce, 2007):

- Children name and rearrange objects one by one in a crowd, count similar objects on a walk (trees, park benches, leaves on a flower), count things that are few or many.
- They try to count backwards, count in pairs, three numbers aloud, two, three very quietly and learn counting.
- They play with a calculator and other objects that show numbers (phone, cash register, etc.), discover numbers on the screen and name them, gain experience with the meaning and notation of the number zero.
- Count objects in a group, especially small groups in a larger group (three spruces among 9 trees, roses in a bouquet of flowers).
- They also count things they cannot grasp, using other paraphernalia (while counting windows on a neighbouring house, etc.)
- They count tidy things (steps, planks in the fence, stairs) and untidy objects (clouds, drops of water…) and with the help of an adult they show and count objects that they cannot touch (in pictures, on houses).
- They play shop, market, cook according to recipes, play land scab, play money games.

2.2. Pre-numerical period

2.2.1. Characteristics before the numerical period

During this period, it is very important which activities parents or educators choose to be able to show the child the right way, as these activities lead the child to form the concept of number. It is very important how we present the concept of counting to the child, because the concept itself is logical thinking that the child must develop through the processes of sorting, arranging, and forming relations between elements and sets. From this we conclude that before the numerical period it mainly covers classification, editing, relations and patterns (Hodnik, Čadež, 2002).

For the implementation of activities for this topic, it is very important that parents or educators choose appropriate didactic tools and concrete materials with which they will illustrate and introduce the child to the concept of number and counting. However, it is not necessary to limit oneself only to pictorial illustrations, as these are too abstract for children (Žakelj et al. 2001).

2.3. Numbers

2.3.1. The meaning of the concept of number and counting

To make it easier to understand the concepts of number and counting, children must first understand both terms. They need to know that these two concepts are two separate skills. The very notion of number means the basis without which we cannot communicate with young children. We use a lot of numerical patterns when communicating with children. We will also list some such examples by Ljubica Marjanovič Umek, (2001):

- “A child has got two arms, and two legs, parents and educators then teach him to use its extremities,
- Children have a tricycle to play with, which means that they have a toy with three wheels and their parents repeat this several times,
- With a toy car, they have four wheels, without which the car cannot be driven, "Every man has five fingers on his extremities."

Children encounter numbers for the first time after birth when their parents sing them various songs and similar. In this way, children are learning and repeating numbers. Children are learning by repetition, but this does not mean that they can count, because during this time they are unable to pronounce numbers and count at the same time. During this time, it is best to show the child objects that are arranged, symmetrically distributed, closer together and there are fewer than those objects that are scattered everywhere and are distant from each other or there are more of them (Marjanovič, Umek, 2001).

Slowly, children learn to manipulate objects, namely, they show one animal in a book, they know how to stack cubes one by one in a column etc. Then the child attaches another object to one object, which leads to an understanding of arranging one with one. In this way, the children give real names for numbers one by one, but they can also invent them. In this case, the numbers must be in the correct order, but not necessarily the objects. All previous research (Marjanovič, Umek, 2001) has shown that it is more difficult to count things if there are more, even if the numbers are up to ten. We show the child that its fingers can help in this and that he/she can count to ten with them. When children learn this, they want to say different numbers and thus discover counting from twenty onwards. Children further need to pronounce numbers to use larger numbers (Marjanovič Umek, 2001).

As we have already written, the first signs of counting appear in children when they start repeating after adults, so they also try to grasp the concept of number (Marjanovič Umek, 2001). When children are learning numbers and can count orally, they also try to write down numerical signs, which means that children have developed the concept of numbers. This can happen in children aged three to six years. Every child is different, but this period is somehow appropriate for children to learn the concept of number, the concept of counting, and try to

write numbers with signs or the words they pronounce (Marjanovič Umek, 2001). That means that children start counting when they say the number and correctly show the counted things or objects, each one at a time and does not miss any.

When we are talking about counting, we also mean habits that have a specific procedure that defines adult counting, marks each object in a row count, assigns numbers to each number, uses a standard list of numerators, and recognizes the last numerator as the cardinal number of sets in a conventional order.

Kolar says that children initially communicate and understand certain counting principles, but their ability to coordinate principles is limited. This can be said to be not the same if there is an absence of any understanding of the counting process. She also says that counting is possible even without standard numerators, which she supported with the case of African peoples (Kolar, 2006).

2.4. Counting

2.4.1. The concept of counting

When we say counting, we immediately mean numbers and therefore natural numbers are needed: 1, 2, 3, 4, 5, … We know that natural numbers are ordered. Children soon become aware of this when they count out aloud.

Ferbar says that a sequence of natural numbers is like a poem with a definite beginning and end. The further we go from the beginning, the smarter we are. In the beginning we count to three, as we learn from fairy tales, and then to number five, for which we often use the fingers on our hands as an illustration. A further illustration is the two hands on which the ten fingers are located. Ten is also found in money (Ferbar, 1990).

The activities that professionals can perform before counting are e.g., the forerunners of the numbers we encounter in fairy tales with three repetitions, in which the father has three sons, the king three daughters, and the dragon in the cave three heads. As we have written, special stories and songs are related to the number five, which in turn refer to five fingers on one hand. Rhythmic counts are very important for preschool children (e.g.: "Am, bam, five rats, four mice in the same house, howling, rehearsing, out.").

Songs that accompany recurring phenomena are also very suitable for counting in the preschool period (e.g.: "Biba leze, biba gre…"), the mother sings, counts and moves up and down the child's belly with her thumb and forefinger. Poems with writing lines along the rhythm are also very suitable for introduction to counting.

“Names are like counting. Using various names reminiscent of numbers, namely (Ferbar, 1990)”:

- »2 Directions: forward, backward, left and right.
- 2 stages of occurrence: beginning, end.
- 3 levels before the start of the match: ready, pay attention, now.
- 3 daily meals: breakfast, lunch, dinner.
- 4 seasons: spring, summer, autumn, winter.
- 5 fingers on the hand: thumb, forefinger, middle finger, ring finger, little finger.
- 5 consecutive days: the day before yesterday, yesterday, today, tomorrow, the day after tomorrow.
- 7 days a week: Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.
- 12 months of the year: January, February, March, April, May, June, July, August, September, October, November, December.
- 25 letters in the alphabet: a, b, c, č….
- 365 saints in the calendar”.

All the above are characteristics of adapting elements of a set of signs or characters to elements of another set (Ferbar, 1990). The count is also very characteristic in that the child quickly understands the feedback of parents or a professional, on whether it correctly recognized the numbers, counted correctly and whether it already knows something, as the solution is unequivocally correct or incorrect (Japelj Pavešić & Justinek, 2011).

In addition, it is necessary that the professional understands the individual steps of learning and knows how to adapt the content for children and expect answers at their level (Japelj Pavešić & Justinek, 2011).

Organizing is very much related to counting, so children in the preschool period learn to organize objects among themselves, which later proceeds by adapting the concept to a concrete object and by adapting words for numbers to an individual object. Children as young as 4 years of age learn that the last number they uttered when counting represents the number of items counted. Until then, for children, counting is just a process of organizing. Given that they are very interesting for children in the preschool period and that they like to present them to adults, counting becomes necessary for the child to play and sometimes they do not readily show it to adults (Japelj Pavešić & Justinek, 2011).

2.4.2. Counting principles and strategies

Research shows that children who already know how to count do not necessarily understand counting, and that these children have developed numerical and quantitative notions. Such a process requires the use of concrete illustrations and appropriate didactic tools. To say that children understand the concept of counting, of determining the number of counted elements, they must be able to internalize the principles of counting, which is the basis for understanding counting (Hodnik, Čadež, 2002).

According to Hodnik, Čadež, we know some principles of counting, namely (Hodnik, Čadež, 2002):

- that children do not omit any object and count it twice,
- that objects counted as natural numbers are arranged,
- that each subsequent one is one larger than the previous one,
- that counting does not depend on the size of the objects,
- that it is independent of the order.
- Considering that children use different strategies when counting, we will also list some strategies, namely (Hodnik, Čadež, 2004):
- children count objects that they can also move (placed in a row, circle, or cluster),
- children count objects that they can touch and cannot move (pictures in a book, flowers on a tablecloth, etc.)
- children count things they see but cannot touch them (distant houses, trees, people),
- children count things they cannot see (doors in the apartment, windows in the apartment, etc.)

We have already written that children experience their first mathematical knowledge in kindergarten with the help of an educator who uses opportunities for children to achieve mathematical goals at their age level through daily spontaneous planned activities (Marjanovič, Umek, 2001).

The various math activities that professionals include in their daily plan should be a constant habit so that children can achieve math goals. At the very beginning, children encounter mathematics, which is in the form of a name and a symbol in the space for clothes and shoes, in the form of a conversation about how children should wear their shoes or slippers (left and right), when drawing a depiction of children's authenticity. At their morning snack or at breakfast, the children stack napkins, count and sort utensils, and then put away all of the utensils. Games around the corner or on the school playground can also be interesting, so when planning, it is very wise to explain to children several games that will help them count, for example counting jumps, throwing balls at a distance, counting steps, running, etc. A daily rest is also planned because certain children prepare deckchairs and count them, and then count how many stories they have read so far, what time it is etc. (Pušnik, 2016).

All activities must be interesting and successful for the children to understand their goal.

2.4.3. Counting principles

We should never ask children to use the agreed counters in the agreed order. Uniform markings in a certain order are very important, but they must have some arbitrary purpose in order not to refer to objects in a specific case (Kolar, 2006).

According to Kolar, we know five principles of counting, and these are (Kolar, 2016):

- The principle of inversely uniform arrangement (pair formation). In this principle, we assign only one name to each item counted, so that the child can more easily count the items and separate them from those already counted. All of this can be done mentally or physically. It is very important that the child uses each word only once.
- The principle of orderliness. This is a principle because children use different words to count, which must be arranged in a constant order.
- The principle of cardinality. This principle says that the last name of the numerator used in the count is special because the children thereby determine the property of the set. This principle develops later because children must achieve the first two principles before they can achieve even that.
- The principle of abstraction. This principle says that children need to know the previous three principles and then be able to apply them to any multitude of things, both physical and conceptual.
- The principle of irrelevance of the order of counting. The name itself says that the order of counting is irrelevant and that children who learn it know that a certain numerator does not define a certain object, and that the numerators used are arbitrary and tied to a certain object, and that the cardinal number does not change regardless then how they count.

3. Practical exercises

The purpose of the article is to investigate and describe the meaning of counting in kindergarten and the first grade of primary school, and to perform mathematical activities to determine whether children are sufficiently acquainted in the period of concrete operational thinking (according to Piaget's theory, Piaget, 1959, 1977). They already know how to count from one to ten, in the second to twenty, in the third to one hundred, for their very development enables them to trust their understanding of logical relations between phenomena, despite everything that happens in their head (Marjanovič, Umek, 2009). At the same time, this article presents some didactic games using didactic aids that professionals must use in their professional work.

The literature reviewed and used in Slovenia in the field of counting in the preschool period is not very extensive and does not have much momentum in the field of the chosen topic. The results of well-known authors (Kolar, Hodnik Čadež, Marjanovič Umek) show that counting is possible and successful in this period, and that children learn to count to 5, 10, 20 very quickly, and some children even more. Mathematical activities help a child aged 3 to 6 with various activities related to different subjects.

The research questions we chose, and which were our guide for writing the paper and enriching our professionalism are the following:

1. Do teachers know how to choose the right activities to present counting to children?
2. Do children understand the concept of counting?
3. Do children learn to count?
4. Which games are suitable for children in the concrete operational mental development?

To prepare the article, we researched the term sense of counting in the first-grade children. We used qualitative research and a descriptive research method based on the already researched theories and explanations. The research is designed hypothetically or critically and based on our own opinions. The research was not open, but it was conducted following pre-set research questions we wanted to implement. We wanted to explain and clarify which mathematical activities are suitable for performing mathematical professional work in the first grade and how professionals are professionally trained to perform and select this activity.

Based on the literature and sources, we formulated research questions that were the research guide and which we tried to answer.

Therefore, we believe that it is necessary that a professional in the field of education, and especially all parents who are with their children every day, try to read some literature on this topic and get acquainted with the child's development, and prepare tasks through which they can help the child to develop its psychophysical and social development, because mathematics is also a subject we need every day. With numbers we encounter everything everywhere; with counting we count different things, objects, we add and subtract, and much more. Therefore, we believe that we, parents, teachers can try and cooperate in improving the child's social development.

In the period of concrete operative thinking children must learn mathematics through play, especially numbers, counting, addition, and subtraction. Given that the topic of the research is the meaning of counting, we must say that children are capable of this and that we can use interesting competitive games to help children count things and sort them, and finally determine that the last number was also counted by the total sum of all counted items or things.

To carry out activities in the field of early teaching of numbers and counting, we will present some games that will make this easier for children.

4. Didactic games and activities

In this section, we present some games that professionals can use in both kindergarten and school. With these games, children would happily fall in love with math and learn it easily.

The first game that could be presented to children in the first grade of school, so that it could diversify the subject of physical education, is the one where we use toys, e.g., three dolls and three cars. The game is related to the subject of physical education and takes place in the gym. It is suitable for children aged four to eight. We inform the children that we will put the dolls and cars at the right end of the gym, and that they will stand behind the drawn red line on the left side of the gym. The boys run first, as their task will be that while we count to five, the boy will run to the right of the gym and bring as many dolls back as possible. So, we give the dolls to the three girls waiting in line. When the boys are done, we tell the girls to stand behind the red line and then, at the signal, they run to the right side of the gym, and bring as many cars as they can to the three boys. We repeat the game several times and change toys and teams. At the end, we present the winners, and introduce the children to counting to five. The kids count with us.

The second game is related to language. The game is intended for children aged three to eight. The game takes place in a reading corner where children sit in a circle. The purpose of the game is to read an interesting story every day. We choose a few children who have the task that while reading the story, with the help of fingers they count how many people, animals or objects we encountered in the story. Then the children present how much they have counted. The other students who listened confirm whether their friends are right or not. In the end, we say the correct answer.

The third game is related to music. We sing a few counts and let the children know that the one tht will be last in the count is placed in a certain corner (first corner: art, second corner: creative, third corner: dance). They work according to instructions in every corner. Kids expect me to start (e.g., Eeny, meeny, miny, moe, Catch a tiger by the toe. If it hollers/screams let him go, Eeny, meeny, miny, moe.). Certain children immediately sit down at a certain table because they are waiting for further instructions, because we prepare certain tasks related to counting.

The fourth game is didactic and is a little more difficult as the children must think, count, and finally present the objects counted. It is intended for children aged five to eight. We play it in the casino. There are some items in the box that the child must count on my sign and count to 10, count the items and at the same time look at how many types of colours the items are. (e.g., there are five cubes in the box, two are red and two are green, and one is white). Each child tries and finally tells its opinion, and then counts the cubes regardless of the order or certain colours.

The fifth game is such that one child draws 6 popular shapes on the playground with the help of a chalk (square, bubble, heart, circle…), which it then uses for a sonic jump By throwing

wooden cubes and the number played by the wooden cube. It also shows how many sonorous jumps children must make. The one who will jump six times or the one whose dice thrown several times falls to the number six, is the winner. We also continue the game by writing numbers up to 5 on the school playground.

We can list other games: counting family members, visiting the farm, and counting the animals on the farm, counting the table in the casino and all the other items. For all these games we can choose didactic aids (cardboard, poster, paper, plastic, plates, and various substances) with which we can help ourselves in the implementation of the game of counting and other activities in mathematics.

5. Conclusion

From a theoretical perspective and personal reflection, we conclude that it is imperative that parents acquaint children with numbers at home, through play, through field trips, through various organized celebrations, and so on. In the case of children who spend a lot of time in school and spend only night-time with their parents due to work obligations, they must learn a lot of material in school, because they learn basic mathematical concepts through play. Other children who already work in this field at home will also repeat and complete all the things, and with some prior knowledge they will be better than the children who do not study at home.

We conclude that professionals in the field of education must be well prepared in the field of mathematics to be able to choose the right didactic games and tasks in order to show the child the basics of mathematics. Professionals must prepare interesting mathematical contents every week, through which they will acquaint children with numbers, sets, counting, etc.

Any activity chosen by a professional urgently requires prior psychophysical and social analysis of the child to facilitate the determination of proper play. Through games and play corners, we conclude whether children can do something and at what level, and whether it is necessary to adapt the content at a lower level.

Professionals need to improve any observations and identified errors. This means that, with the help of parents and teachers, they must present didactic games on counting at a higher level so that children can progress to further material or activity.

To be able to do all these things, cooperation, trust and motivation for work, creativity and improvements in the pedagogical field are needed.

We conclude that cooperation and trust between parents, children and educators are very important, because only in this way children will be ready to learn mathematics and upgrade it, and educators will confirm their solidarity, willingness, and professionalism to help children improve their psychophysical and social development and especially in learning about mathematical activities in kindergarten, which is the foundation for everything in future.

Given that nowadays professionals in the field of education are facing problems with teaching aids and games, we can confirm that they can make these themselves, so that they can present counting to children in the easiest way. For each day, together with the children, they can make various accessories from cardboard (make and colours cubes that they can then count), plastics (make plastic Santas which they count and make together for each group during the holidays), paper (make colouring books) with different motifs of cartoons and similar, in order to attract their attention when counting motifs, objects etc., and writing numbers), from flour (they make different cookies, balls, stars), etc.

Professionals must be constantly educated in the field in which they work to achieve the desired result and attract the attention and confidentiality of both parents and school management.

References

Bahovec, E. (2007). Kurikulum za vrtce: predšolska vzgoja v vrtcih. 2. izd., 3. natis. Ljubljana: Ministrstvo za šolstvo, znanost in šport: Zavod RS za šolstvo.

Ferbar, J. (1990). Štetje (priročnik za vzgojitelje predšolskih otrok in učitelje). Novo mesto: Pedagoška obzorja.

Hodnik Čadež, T. (2002). Cicibanova matematika. Priročnik za vzgojitelja. 1. izd., 1. natis. Ljubljana DZS.

Manfreda Kolar, V. (2006). Razvoj pojma število pri predšolskem otroku. Ljubljana: Pedagoška fakulteta.

Marjanovič Umek, L. (2001). Otrok v vrtcu. Priročnik h kurikulumu za vrtce. Maribor: Založba Obzorja.

Pavešič Japelj, A. & Justenek, A, Domicelj, M. (2011). MATEMATIKA za otroke. El. knjiga. Ljubljana : GZS, Center za poslovno usposabljanje.

Žnidarič, S. (2010). Štetje in poznavanje številk v vrtcu - razlike v starostnih obdobjih. Diplomsko delo. Maribor: Univerza v Mariboru, Pedagoška fakulteta.

Žakelj, A. Prinčič Rohler, A., Rerat, Z. Lipovec, A., Vršič, V. Repovž, B., idr. (2001). Učni načrt. Program osnovna šola. Matematika. Ljubljana. Ministrstvo za šolstvo, znanost in šport: Zavod Republike Slovenije za šolstvo.