



CHILDREN'S DRAWINGS – RESOURCE FOR DEVELOPMENT AND OBSERVATION OF PERCEPTION OF NUMBERS OF CHILDREN

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Abstract: Children's drawing is one of the most appropriate approach to knowing children, their individuality and also their perceptions. Child is not always able to express their thoughts precisely, because their vocabulary is still incomplete and is gained just lately. In our paper we concentrate on drawing as a communication means, with which we can obtain primary numerical conceptions of children. We deal with observation of children's perceptions of number. We investigate process in which to numerical information the conceptions of numbers are assigned. The numerical information is word *three* and the child's drawing is used to mediate the numerical conceptions of children. The activity was realized with the children in the kindergarten. We analyzed draw children's conceptions of number 3 and created concept map from those drawings.

Key words: children's drawing, number conception, concept map

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1. Introduction

It is difficult to identify preschool children's knowledge about the world they live in. One way of getting to know their representations is studying their drawings (Dulamă, Ilovan, Vanea, 2009). According to Piaget (1970), the drawing is a form of semiotic function, which has its place between the symbolic game and figurative conception. R. Davido (2001) claims about the child's drawing that a child probably does not already know or does not already want to express himself/herself verbally; however, his/her drawings can reveal much about him/her and his/her real and imaginary world. The quality of not only motoric but also of cognitive and emotional growth of a child is reflected exactly in the child's drawing. It is the drawing that helps to organize the world into the unity of shapes. Children's drawing is one of the most appropriate approach to knowing children, their individuality and also their perceptions. Children like drawing; it is pleasant activity for them. Drawing as tool for knowing children is used:

- for testing mental level,
- as a communication means,
- as a means of observation of children's expression of their inner world,
- as a means of expressing children's knowledge about their body and its position in space.

We concentrate on drawing as a communication means, with which we can obtain primary numerical conceptions of children in our paper. The most common means of communication is speech. However it is not the simplest means. Child is not always able to express their thoughts precisely, because their vocabulary is still incomplete and is gained just lately. That is why drawing is popular means of expression, because it does not need any skills except holding pencil in the hand. Drawing is not only one-sided description or self-expression of child in relation to their social surrounding, but it becomes a dialogue between the child and reality known by them. It also reflects certain ontogenetically and mental level of a child, their skills and knowledge. Drawing is for most children pleasant and joyful activity; with these assignments they are not afraid of task and they get to it without obvious displeasure. Child is motivated in drawing with what they love, is interested in or is troubled with. They try to express abstraction, thoughts and attitudes by drawing.

It is clear from the above that children's drawing is an appropriate entrance gateway into the inner world of children and also in observation of preschool children's perceptions of number. If we want to take a deep look into the primary conceptions of numbers of children, the information created in the first phases of mental process and closely connected to his/her private world of numbers are very important.

2. Development of preschool children's conceptions of number

According to Hejný, Stehlíková (1999), when investigating the exteriorization of the processes of children's thinking about numbers, we will distinguish two processes:

- the process, in which to different conceptions of numbers the numerical information is assigned,
- the process, in which to numerical information the conceptions of numbers are assigned.

The numerical information is such information (a word, move, gesture ...) that contains at least one number.

Appointed authors analyze the process of the emergence of the world of numbers from the world of things. The introduction of the world of numbers Hejný realizes in accordance with Popper's idea of three worlds. He classifies the world of numbers as a part of the second and the third world. Hejný understands the world of numbers as the structure with the essence in person's semantic conception of a number. The conception consists of three components: the number, its attachment to the world of things, and the knowledge of an individual, in which the number and its attachment are situated. The world of things (the first world according to Popper) interprets Hejný as the set of all the human's conceptions of things, events, situations and relations existing within the perceived world. The world of numbers originates within the world of things in the course of the intellectual growth of children.

The process of the emergence of the world of numbers from the world of things has two components:

- Verbal: the emergence concerns the words –number words. The child acquires them as the sounds whose meaning he/she understands only vaguely. Words *three, four, five* are intuitively grouped together such as words *white, blue, green*
- Semantic: the emergence concerns the meaning of the numerals. This component is crucial for the construction of the world of numbers. The process of construction is divided into four developmental stages:
 1. The stage of opening of the world of numbers – the child begins to distinguish between the singular and the plural, i.e. between one and lots of.
 2. The stage of separated conceptions – the child already has the conception of what three balls means or what three fingers means, but perceives them in isolation. He/She already does not know that these conceptions represent the same amount of things.
 3. The stage of universal conceptions – the child knows that individual conceptions of numbers may stand one for another. Fingers or counters of an abacus are becoming universal models for the child. The achievement of this stage means the construction of the world of numbers that is associated with the world of things.
 4. The stage of abstract conceptions – the child is already able to manipulate with the conception of “three”, “four”, etc. meaningfully. He/She does not need to frame this conception within the world of things. The world of numbers gained independence

Children encounter numerous situations that bring them into contact with sounds, symbols and meanings that relate to numbers. Examples of these include counting rhymes, their ages, clocks and calendars, number on houses, buses and shirts, but most importantly, the counting and recognizing of small numbers of objects such as snacks and sweets or the number of dots on a die. From all this, they learn that numbers can have several different meanings and functions:

- ”magnitude”, the quantity of five sweets,
- “order number”, the fifth item in a row,
- “measure number”, the age of five years,
- “label number”, bus number five,

- “calculation number”, two plus three is five. (Treffers, 2001)

3. Mathematical skills of preschool children

According to Gruszcyk- Kolczyńska (2007) children are competent for school education when they gained skills in the field of:

- *counting* – be able to count objects in the most possible range (counting one by one) and distinguish between correct and incorrect counting,
- *adding and subtracting* – to know the result of adding and subtracting, count with the use of fingers or other models,
- *equality* – to know how to determine equality in two ways: by counting objects in comparing groups and also by creating couples from the objects in comparing groups.
- *numbering, using ordinal numbers* – to know how to create sequence of objects according to largeness (from the smallest to the biggest and in reverse), assign ordinal numbers to these objects
- *spatial orientation* - to orientate in the structure of their own body and distinguish between the right and the left side, to know how to determine direction in the space, to begin from themselves and determine position of objects in relation to their own person
- *length measuring* - to orientate in the way of measuring length,
- *periodical organization of the time* – to orientate in continual rotation of days and nights, also days in the week – to know their names and fixed order, also names and order of month in the year – to orientate in the calendar.

4. Characterization of the activity

At the beginning of the activity we ask children to draw what they imagine when we say number 3. We let the children work individually while our aim in this stage is to observe the ability of children to assign concrete number conception to given number.

After drawing we have a dialogue with children and tell them several examples from real life where they might come across the number (at the advertisement, in the elevator, at the competition...). We observe how their conception of the number changed after our intervention in this phase of the activity. Then we ask them to draw their imagination of number 3 again. Children present their drawings and describe depicted conceptions verbally. After presentation we fix all the pictures to the board and ask children to arrange the pictures into groups according to some similarity and to explain their choice. Thus the concept map of children concerning their images of number three is created. At the end the children are asked to look for the number three in their domestic environment (Pavlovičová, Vasková, 2008).

5. The evaluation of the activity

This activity was realized with the group of 20 children in the age of 5 to 6 years in the kindergarten. The whole activity took 60 minutes. All children participated actively in the activity; they were concentrated for 35 minutes. After this time had passed, 10 children were able to concentrate on the next activity. Children that up to now are not able to concentrate for longer time on one activity kept running away from our activity. Two of them are diagnosed as ADHD.

The pictures of children were arranged into the groups according to their conceptions of numbers.

There are various classifications of conceptions of natural numbers into classes and subclasses. In our paper, we will sort the children's conceptions into the following groups:

1. the natural number as a cardinal number, i.e. for counting (the number of dots on the face of a cube, the number of fingers on the hand, three pears, five cars, ...)
2. the natural number as an ordinal number, i.e. for sequencing (the first in the finish, the third floor, ...)

3. the natural number for identifying (the class 3.A; the bus No. 7; its 12 a' clock; ...)

Children figured number 3 as the quantity or as an identifier. Six children produced rich pictures, however, without any connection to number 3; one child figured only the shape of number 3 that did not express any conception of the number. After the dialogue was held with children about number 3 and its various forms around us, the children drew pictures related to number 3 again. In comparison with the first illustration, in the new portrayals number 3 appeared represented as an identifier more times, and for the first time as the order (Table 1).

Table 1

The illustration of number 3	Number of children before the dialogue	Number of children after the dialogue
Quantity	12	13
Order	0	2
Identifier	1	4
Shape of the number	1	1
No model	6	3

The enhancement of children's conceptions of numbers which was influenced by our dialogue with children, we can see in the table 2. Five children expanded their primal conception of number of new models as follows:

Table 2

Number of children	Before→After the dialogue
2	quantity→ identifier
1	identifier → quantity
2	quantity → order

Some children could react correctly after the dialog, but three of them were not able to create any concept to number 3 in their pictures even as those pictures were richness (figure 1). Children who did not create any model seemed in general to be weaker in other educational activities, too or these were children with delayed school commuting.



Figure 1. Pictures without concept to number 3

Other group of children was able to assign to numerical information only one or two conceptions of number 3. Thus it can be concluded that they so far do not realize that the same amount of different things represents the same number, they perceive them in isolation – they have reached only the stage of *separated conceptions* (figure 2).

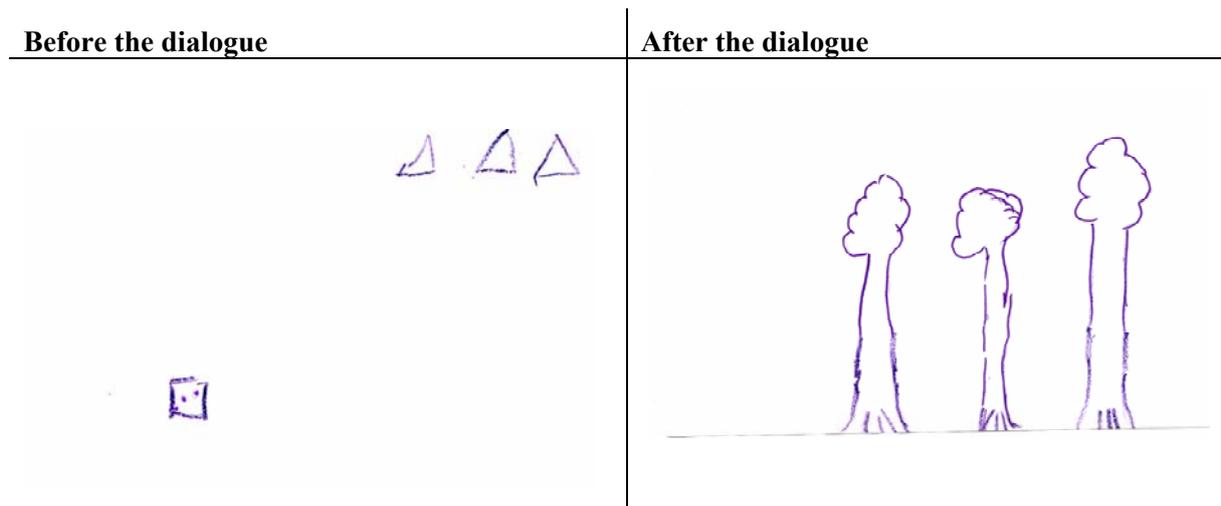


Figure 2. Separated conceptions

There are pictures of one boy who was characterized by his teacher as a child skillful but unsure in the figure 3. We can see big differences between his pictures before and after the dialogue. He created only one model of number three at the beginning, his drawing is very simple. Richness of the second drawing confirms that he was only not sure about the given task. He created number three as a quantity, as an order and also as an identifier after the dialogue.

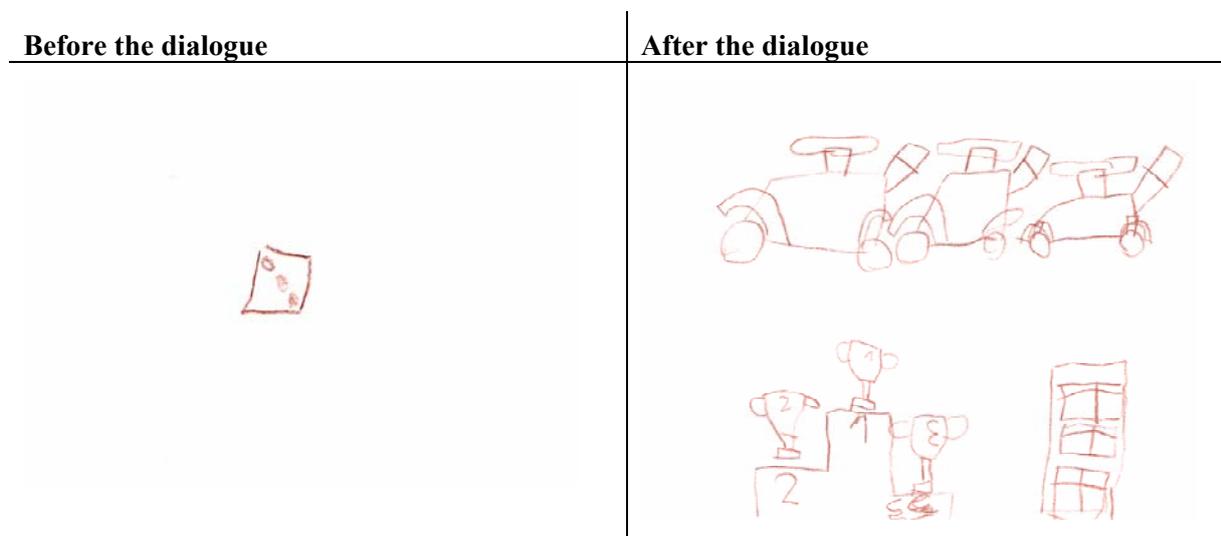


Figure 3. Differences between pictures before and after the dialogue

Two children created interesting conceptions, which we have labeled “3 in 3”, i.e. in one conception of number 3 another conception of this number appears – three tables with three drawers, three cubes with three dots, three numbers 3 ... There are many conceptions of number 3 in both pictures. The enrichment of number conceptions occurred in the second phase – the child did not depict number 3 only as the quantity, but also as the order – the third on the podium. The models “3 in 3” can be found in both phases. Following the richness of drawings, we can conclude that the child is aware of the fact that the same amount of different objects represents the same number, i.e. the child has reached the stage of *universal conceptions* (figure 4). Similarly various pictures were produced by another four children.

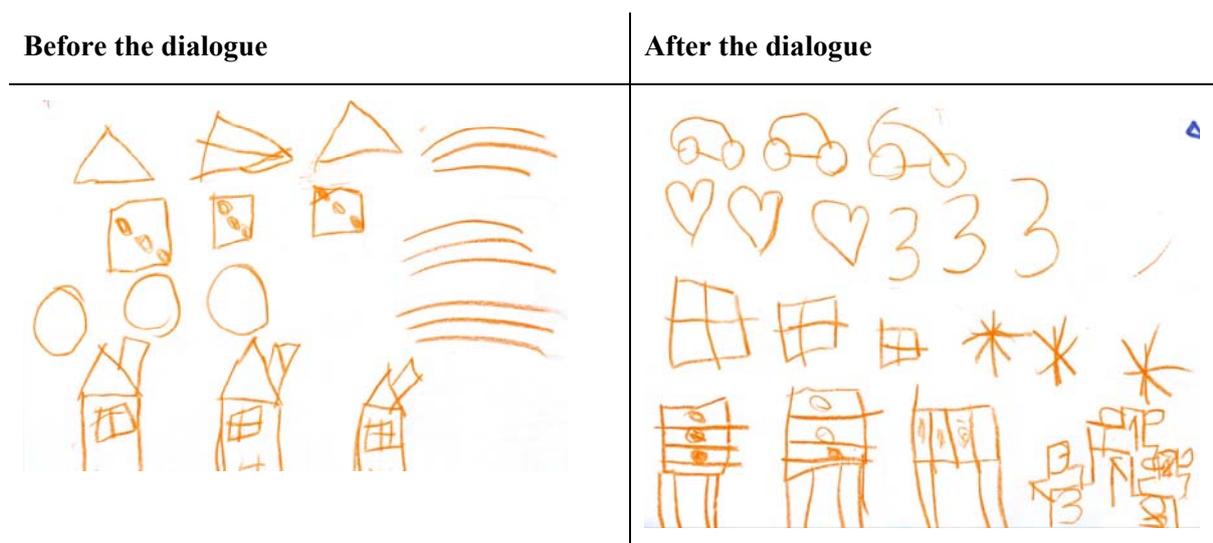


Figure 4. *Universal conceptions*

The overall activity of children, as well as the richness and diversity of their drawings confirm that the preschool age children are playful and spontaneous in expressing their conceptions and feelings. The drawing proved to be a very appropriate form of expression, because even a withdrawn girl refusing to communicate with us verbally expressed herself in this way. Even the children unable to connect their conceptions with the world of numbers were drawing; moreover, they were able to react appropriately the next day, too. This confirms that our creative activity had particular influence on children of this age, even if they seemed to be passive at that time.

In the figure 5 we can see drawings of a girl, who was characterized by her teacher as skillful but frightened child, who is afraid of the unknown. This girl doesn't want to communicate with us verbally, she started crying during talk with us, but her drawings prove that she was listening to us. She understood our task and her numerical conceptions were influenced by our dialogue with children in which she did not take part.



Figure 5. *Drawings of a skillful but frightened child, who is afraid of the unknown*

Each child presented his/her picture and fixed it to the board. After that, the children were asked to group those pictures that they think have something in common. We tried to create mental map with children. **Mental maps** are playful, creative, precise, simple yet rich in content. They are an excellent

motivational and planning tool as well as adequate expressive means, which develop creativity and communication (Pavlovičová, Švecová, 2009).

Thus the groups of three trees, three flowers ... were created. It can be seen that children grouped only the pictures depicting the same amount of the same things. They also created a group of two pictures depicting train, which, however, did not represent any conception of number 3. The created concept map points to the ability of children to group the same number conceptions. Within the process of shared sorting of pictures, the children expressed themselves on the level of separated conceptions of numbers within the semantic component of the process of the emergence of the world of numbers from the world of things. It can be concluded that children's conceptions are at this age strongly fixed to the world of things. Particular pictures are, however, the evidence of the fact that some children have already reached the stage of universal conceptions. Presented activity was enhancing and interesting for the children, as they were able to react appropriately upon this topic and to look for another "threes" in their surrounding spontaneously even later on.

We have produced the following concept map of number 3 together with children (Figure 6).



Figure 6. Concept map of number 3

6. Conclusion

Common educational activities in nursery school are part of a process during which children assign the numerical information to different number conceptions. In our activity, children's task is to assign different number conceptions to given numerical information. The whole activity helps to build and develop children's number conceptions and also support their creativity, verbal and non-verbal communication, independence in solving problems and cooperation.

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