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Research Article

RECOGNIZING AND NAMING THE SHAPES OF GEOMETRIC FIGURES USING APPLICATIONS WITH KINDERGARTEN CHILDREN

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Abstract

For a long time, the period of preschool education was marginalized, and a small number of scientists studied the effects of working with children of that age. Fortunately, lately, the situation has changed a lot. Finally, that period gained in importance as much as it should. If children do not master certain knowledge and skills in some period of life, it is not disputed that they can master all that in some period later, but that way we slow down children's progress. Visualization of activities carried out with children in kindergartens is very important because children learn best when they combine as many senses as possible. Geometric contents are suitable for working with children and there are many creative possibilities for their realization, so it is the obligation of all of us to constantly examine these possibilities and constantly improve them. In the previous period, we conducted a similar research but using applications with models of three-dimensional geometric figures. In this study, the sample consists of 44 children from 3 to 6 years old. The individual approach examined their ability to name and recognize the shapes of two-dimensional geometric figures (circles, squares, rectangles, triangles) through applications using colors (red, yellow, green, purple and blue) to attract children's attention to the offered applications. The answers obtained are important information for further research and important information for the creation of new preschool curricula.

Keywords: Two-dimensional geometric figures, Applications, Mixed age group, Kindergarten case study.

INTRODUCTION

Preschool education is the first link in the organized education system that children attend. In order to improve the quality of this overall system, it is necessary to constantly study all its segments. The influence of preschool education is mentioned as an important factor of achievement. In mathematics, each year of the preschool program contributes to better student achievement. The difference between students who attended the preschool program for three years and those who did not attend the TIMSS 2019 survey was 32 points (APOSO Bulletin, 2020), which indicates the importance of that education. Therefore, the necessity of improving preschool education is confirmed by the results of international research.

During their development, children think differently, progress differently in certain periods. Eg. in one age group, some children perceive only shapes, but without the ability to identify and distinguish them among many shapes, while some children recognize shapes according to their appearance. When drawing circles, squares or triangles, they often draw them the same way, as an irregular curved line (Clements, Battista, 1992). So, at different levels, children think about shapes in different ways. At the initial level, a square can only mean a prototype square. At the next level, the square can be variations of various shapes, which look like a perfect box. At the next level, the square is a closed figure with four equal edges and four right angles. Even at this level, the square is not related to the class of rectangles (Clements, Sarama, 2000). Therefore, this segment needs to be constantly studied and search for the best ways to work with children of that age. Young children naturally like to explore the geometric and spatial aspects of the world around them. There are many opportunities for the teacher to see children's understanding by asking questions, suggesting other activities, showing different transformations (such as two right triangles of the same size forming a rectangle) and providing additional materials (Copley, 2000). Children begin to form the concepts of shape in preschool age. At the age of 6 or 7, these concepts are formed. Young children do not develop their concepts of shapes just by looking at pictures or listening to descriptions, but they develop them by using play blocks (e.g. lego cubes) because they have many opportunities to discover the properties of two-dimensional and three-dimensional shapes (Copley, 2000). For example, young children form categories of artifacts that are characterized by similarity among examples in form (Jones, Smith, 2002). In a study conducted by Clements *et al.* (2018), it is proved that children can have richer concepts of form if the environment in which they learn has certain characteristics, such as: educators need to offer many different examples of a certain form; activities should include a wide range of shape classes; educators need to challenge children with a wide range of interesting tasks; children need to move from sensory-concrete to integrated-concrete cognition; encourage children's descriptions. In a longitudinal study, Farmer *et al.* (2013) proved that the spatial skills of 3-year-olds were strong predictors of success in mathematics for those same children after two years. “Doing”, “creating” and “expressing” mathematics means using and depending on spatial reasoning and spatial representations (Hawes, Tepylo, Moss, 2015). It has been proven that spatial reasoning is closely related to learning science, and that it can be improved (Newcombe, 2016). A strong link between spatial reasoning and mathematics increases the possibility that improving children’s spatial skills may serve as a way to strengthen mathematics learning (Hawes, Tepylo, Moss, 2015). Educators should consider how to incorporate spatial reasoning into their work with children because the use of spatial language in sensitive and precise ways can be crucial for maximum spatial learning (Newcombe, Stieff, 2012). During their training and preparation for working with children, one

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should critically use the available literature, because in the literature that is most often used, certain inconsistencies and shortcomings in the presentation of geometric contents are evident (Nesimović, Pjanić, 2019b). Viewing shapes from different orientations removes children's stereotypical understanding of the appearance of individual shapes, thus supporting an understanding of basic geometric principles (Seah, 2015). Research has shown that visualization can be beneficial for all those who learn regardless of age, gender, experience, and culture (Newcombe, Stieff, 2012). It should be taken into account that children, regardless of age, can be at different levels of opinion (Nesimović, Pjanić, 2019a). The conclusions of a study conducted by Ilany and Ben-Yehuda (2021) are that teachers who are offered a tool that presents content in a well-organized and well-defined format, feel greater self-confidence and competence in teaching mathematics. As a result, these teachers are more likely to involve children in math activities and are more likely to use new teaching methods. Preschool education as a creative process for children presupposes research and fictional content, and for educators challenging educational concepts, teaching aids and methods (Ahlcronal, Samuelsson, 2014). Learning geometric shapes both spatial and planar should go spontaneously through play. A good example of how this can be done is shown in The Fairy Tale from the Land of Geometry (Nesimović, 2019).

MATERIALS

Case study

Kindergarten children are very specific and it is quite difficult to say with certainty the significance of the results obtained in working with them. Sometimes children are happy to cooperate, and sometimes they don't want to. Sometimes they say what they think right away, and sometimes they just say a word or don't want to say anything at all. There can be many reasons: sometimes they don't know what to say, sometimes their vocabulary is not enough wide to express what they think, sometimes they are simply not motivated enough to say anything. Guided by this and the experience conducted in the previous research, we decided to conduct a case study in Sarajevo kindergartens with children from mixed age groups. It was decided to describe and interpret the experiences gained by working with each child individually, respecting the child's will and not influencing the answers that children will give. The study was conducted in natural conditions in kindergarten rooms where all children stay in one corner where the child would not feel completely separated from the others. The sample consisted of 44 children from 3 to 6 years old (more precisely 3 six-year-olds, 16 five-year-olds, 21 four-year-olds and 4 three-year-olds). The obtained results do not allow generalization (due to the relatively small sample), but offer us a deeper analysis of certain phenomena and an understanding of specific cases. So, the goal of this case study of ours is to describe and whenever possible explain the observed phenomena. We used a special method of data collection. We devised five questions for naming and recognizing the shapes of two-dimensional geometric figures. For that, we used specially prepared applications that were shown to the children in a specific order. All responses were recorded. The children were asked simple questions and were not suggested what to answer. Whenever the children wanted, there was a break. The children themselves decided when to return and continue to answer questions. To attract children, strong colors were used on the applications. For each child, the age is also recorded. This information was given to us by the educators responsible for that child / educational group because we were not sure that all the children would know how old they were. We decided to make this study qualitative, but if the number of certain answers is important for us to emphasize a phenomenon, we will allow that kind of quantitative information as well. We conducted the survey through four groups of questions. Each had a different two-dimensional geometric figure in its focus (triangle, rectangle, square, circle). The group of questions was chosen at random. Each child was approached at a time when they only wanted to and worked individually, with strict respect for children's needs. In conversation with them, simplified terminology was used (instead of the term models of two-dimensional geometric figures, we used specific names of two-dimensional geometric figures, thus neglecting their abstractness and adapting it to the age of the children). We will present the results we have obtained by describing the task one by one.

RESULTS

First task

In the first task, children were offered applications with two-dimensional geometric figures (circle, square, rectangle, triangle) and only one application. To arouse children's curiosity, we painted the shapes with strong colors. We asked the children to say the name of the shape shown. The first group of children needed to recognize and name the circle. All the children named it correctly. Another group of children needed to recognize and name the square. Only two children named it correctly. One child said they didn't know, and all the other children said it was a cube. The third group of children had to recognize and name the rectangle. Several children named it correctly, and several said they did not know. We also had wrong answers, such as: triangle, cylinder, as well as the statement that they "don't know, but it looks like a cube".
The fourth group of children had to recognize and correctly name the triangle. Most of the answers were correct. We received each of these answers once: a cube, a circle, a tower, a pine tree and that they do not know. Thus, the children recognized and named the circle without difficulty and the triangle with less difficulty. However, the square and the rectangle presented great difficulties to them. Note that we accepted children's understanding of squares and rectangles as separate terms, because we did not notice in the conversation with the children that they perceive them as if they were one special case of another.

Second task

In the second task, children were offered four colorful applications of the same shapes but different sizes. The children had to compare them with each other and find the smallest shape among them. The first group had applications of circles: blue circle, green circle, red circle, yellow circle, and green was the smallest. Almost all the answers were correct, except for two who said it was a blue circle. It was the first in a series of displaying, which means that the order in which applications are shown to some children could have an impact on their response. We looked at the years of the children who said the wrong years and determined that they were not the youngest children, which means that age did not prove to be a factor that influenced the children's responses.

The second group had square applications, namely: blue square, green square, yellow square, red square, and red was the smallest. We had an identical situation to the one with the circle. Only two answers were wrong and they referred to the blue square. The blue square was the first in a series of displays, which means that the order in which applications are displayed in some children can have an impact on their response. The third group had applications of rectangles: blue, green, yellow and red, and red was the smallest. All the answers were correct. The fourth group had applications of triangles: blue triangle, green triangle, red triangle, yellow triangle, and blue was the smallest. Although we expected most of the correct answers to be in this order, this did not happen. Some answered that it was: red, yellow or they didn't know. So, as they repeated the name of the figure from the application within the first task, there were no difficulties in the name now. The combination of a certain feature (at least) and the name of the figure itself led to certain difficulties only in the case of a triangle.

Third task

In the third task, the children needed to find the required character among the four applications of different characters offered. The first group needed to find a circle among the offered applications: red square, blue rectangle, purple circle, yellow triangle. Only one child pointed to the square, and all the others found the character they were looking for.

The second group needed to find a square among the offered applications: yellow circle, red rectangle, purple triangle, blue square. Among the correct answers were three triangles and two rectangles. The third group needed to find a rectangle among the offered applications: red circle, yellow rectangle, purple triangle, blue square. Among the correct answers were one triangle and one circle. The fourth group needed to find a triangle among the offered applications: purple circle, blue rectangle, yellow triangle, red square. Among the correct answers, there was one square and a rectangle and two children said they didn't know. So, in the task in which they need to notice a certain shape among several of them, minor difficulties appeared, mostly in the case of a square, then a triangle, and then a rectangle, and least of all in the case of a circle.

Fourth task

In the fourth task, the children were offered dots that needed to be joined to get a certain shape, and then next they needed to draw the same shape, but now without the help of dots. The first group had this task with a circle. We had various situations here: some did everything they needed to do, some just put dots together, some just drew a character without dots, and some said they didn't know. Here we want to highlight the response of a three-year-old boy. When we explained to him what to do, he said: "I don't know how to draw. I'm still young, and now I'm leaving because I have my own business." We displayed the drawings in Figure 1.

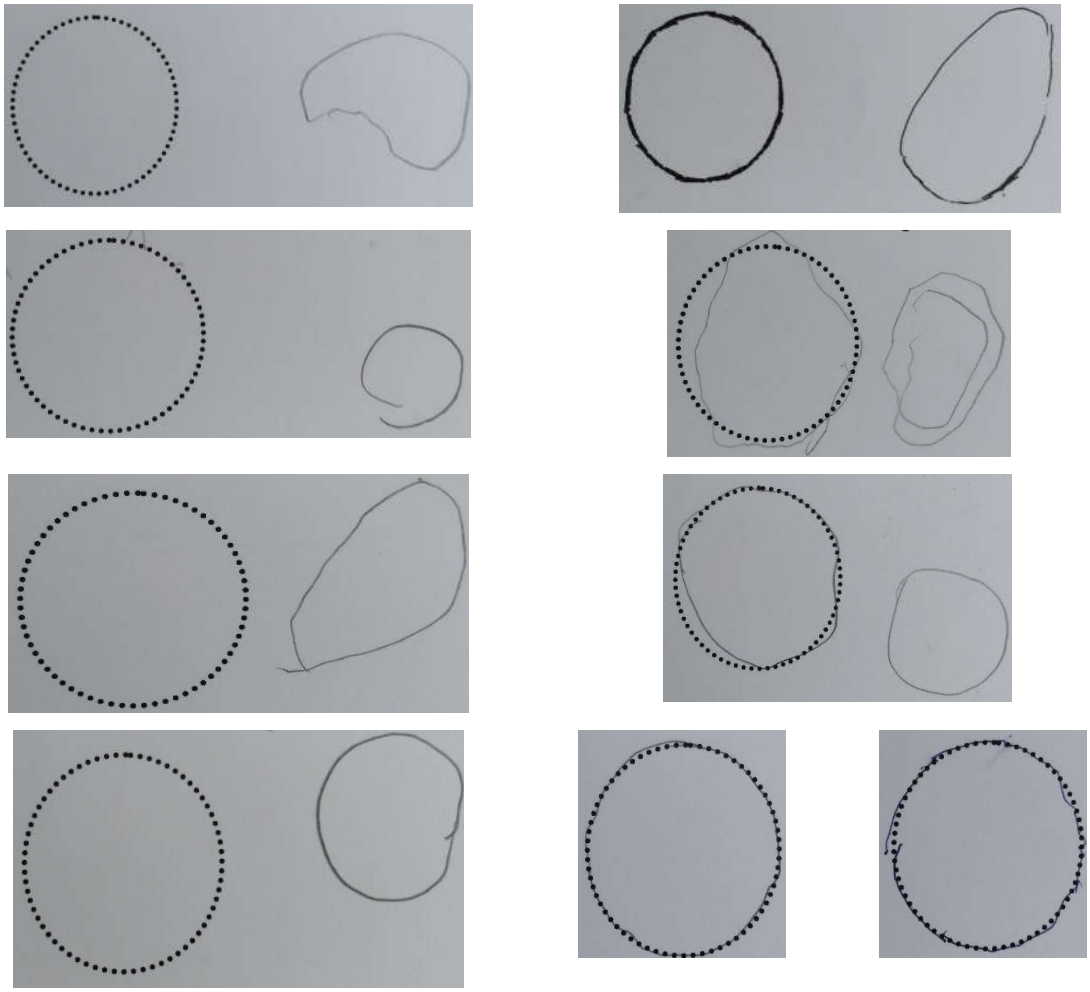

Figure 1. Drawings of a circle with and without the dots

The other group had this task with a square. Here, too, we had analogous situations as in the case of the circle. We have shown the drawings in Figure 2.

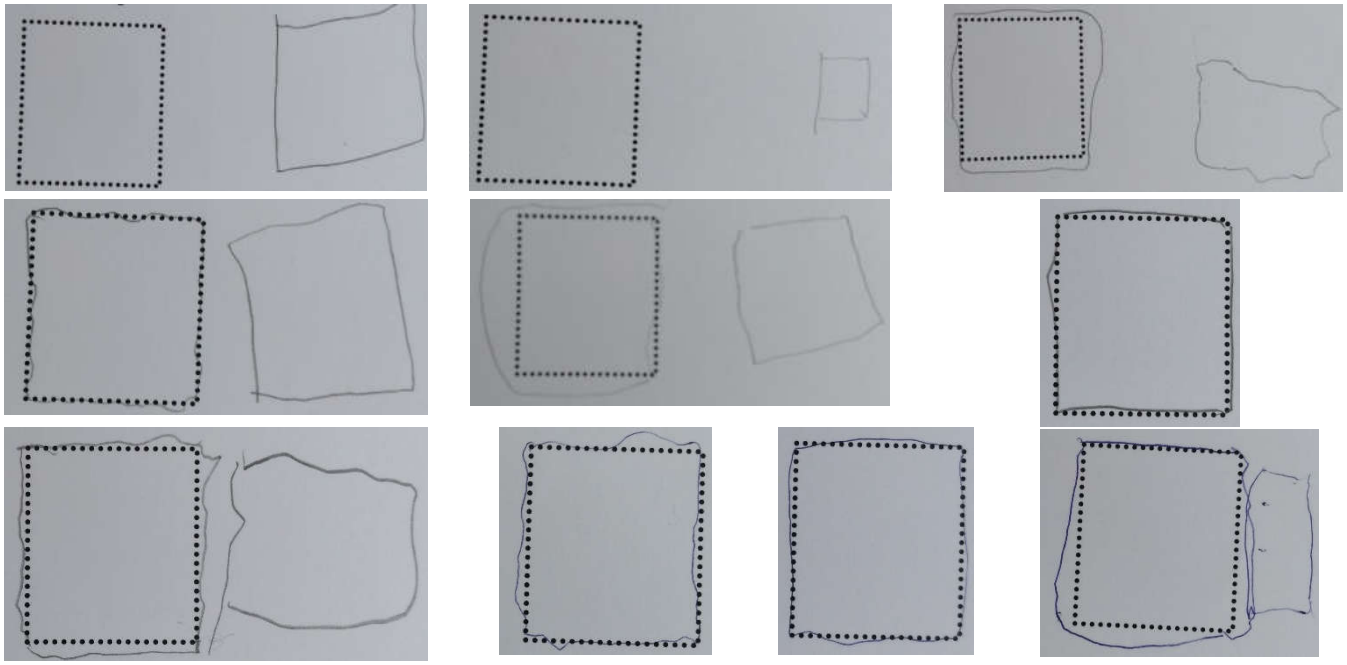

Figure 2. Drawings of a square with and without the dots

The third group had this task with a rectangle. Now, in addition to the completely done task, we also had the case that they just connected the dots and did not want to do this task. We have shown the drawings in Figure 3.

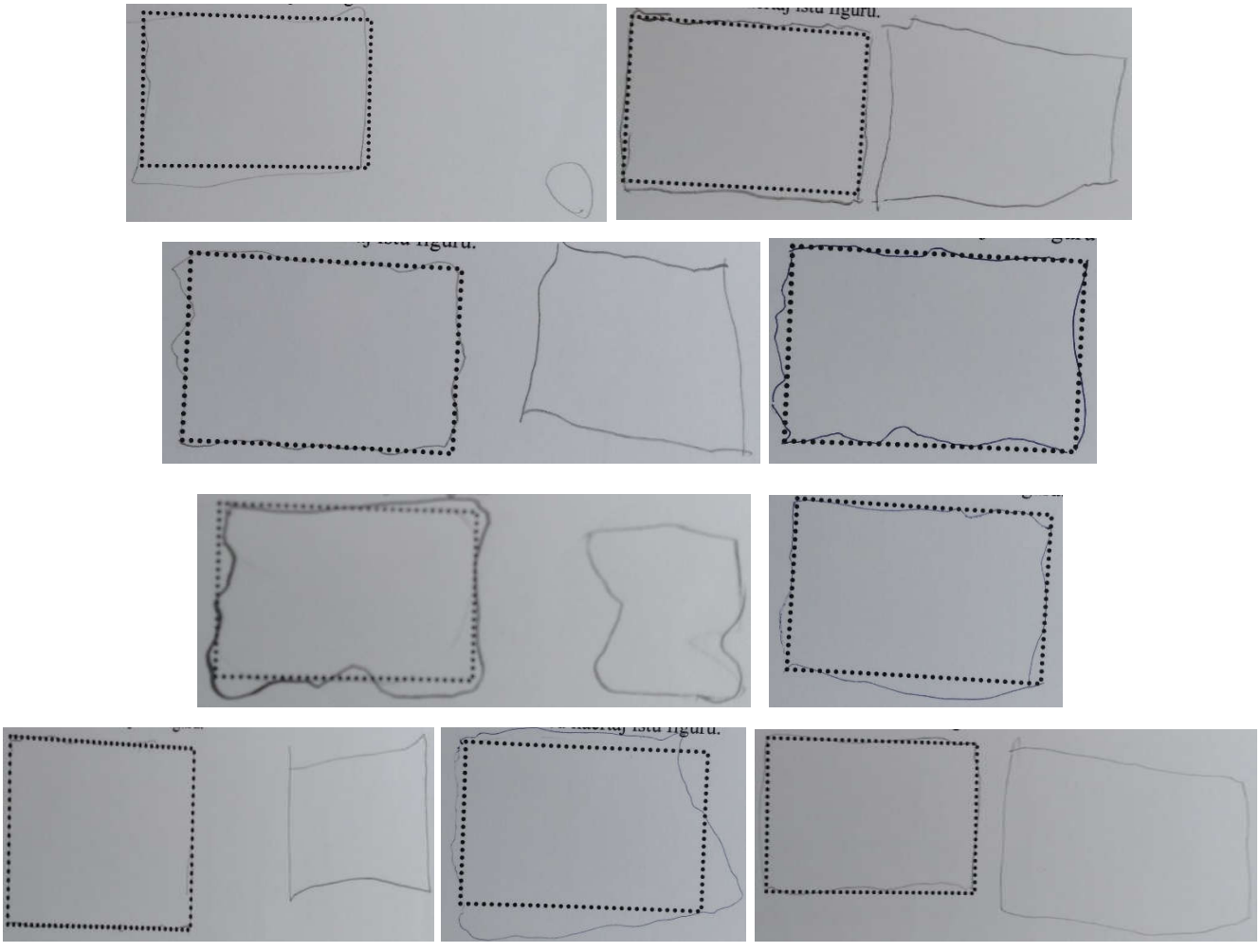

Figure 3. Drawings of a rectangle with and without the dots

The fourth group had this task with a triangle. In addition to the completely completed task, we also had cases where they just connected the dots, and that they drew something. We have shown the drawings in Figure 4.

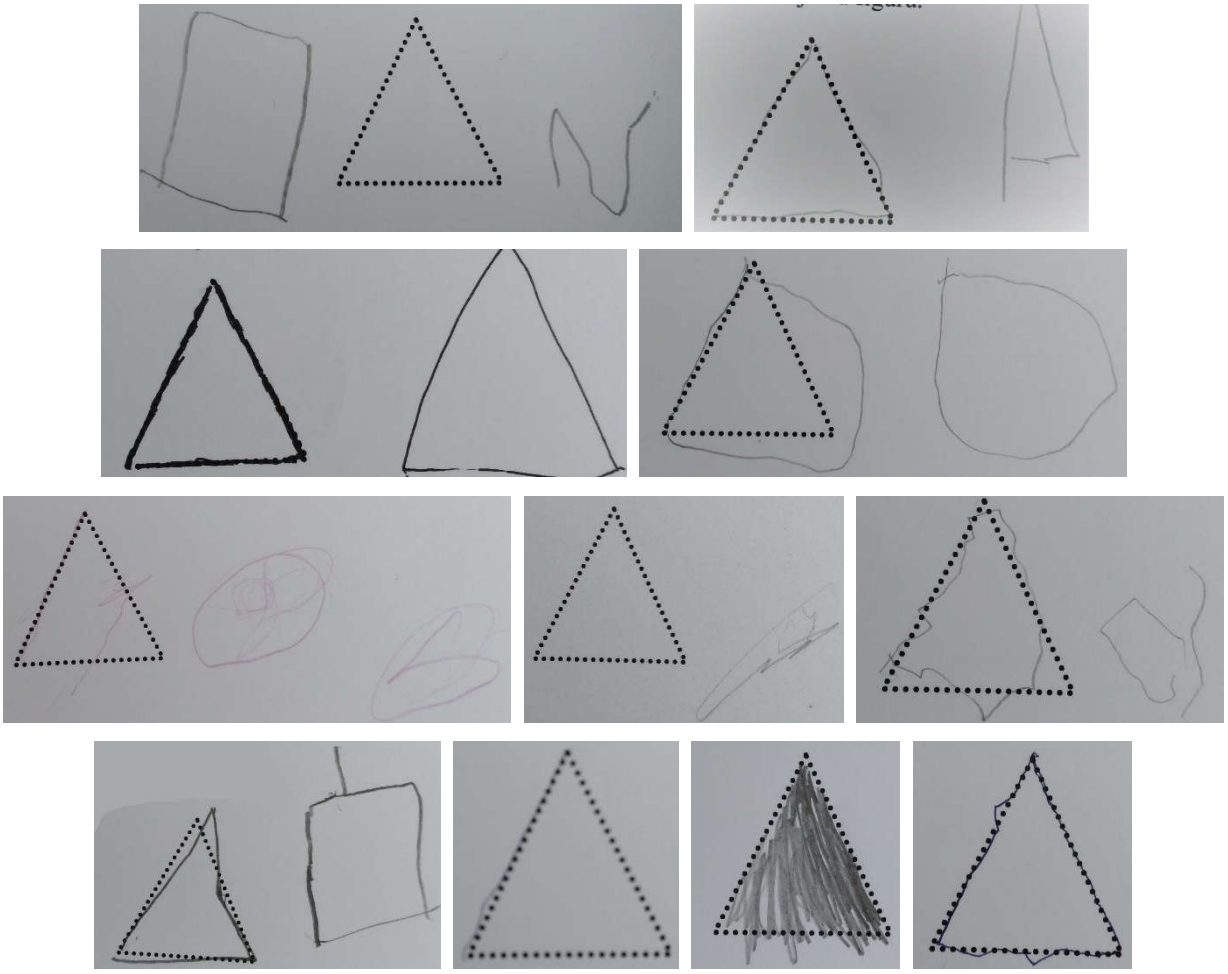

Figure 4. Drawings of a triangle with and without the dots

While working with the children in this task, we noticed that the children were happy to use pencils. They did the task the way they thought they should. Some decided that the task was too demanding for them and did not even want to try, but instead of drawing, they decided to talk about something else.

Fifth task

In the fifth task, the children were offered colorful applications of various figures: a purple circle, a red square, a blue rectangle, a green triangle. They were supposed to name them one by one. The first group which has received questions related to the circle so far, almost everyone recognized and named the circle. Only two children did not want to continue the conversation. When it comes to the square, only two children named it correctly. The others said it was: a cube, a triangle or that they didn't know. When it comes to the triangle, only two children said they did not know, and the others answered correctly. In the second group, which has so far received questions related to the square, only one child answered correctly for the case of the square, one said they did not know, one gave up from further conversation, and all the others said it was a cube. In the case of the circle, half of the children answered correctly, and the rest said it was a ball, one said a cylinder and one said they didn't know. In the case of rectangles, in addition to a small number of correct answers, there were also: cube, triangle, square, and answers that they did not know or that they had forgotten.

In the case of the triangle, most of the children answered correctly. The wrong answers we had were: a square and we also had the answer that they don't know. In the third group, which so far had questions related to the rectangle, half of the children gave the correct answer, and the rest said: a cube, a triangle or that they do not know. In this group, two children refused further cooperation. In the case of the circle, only one answer was wrong (ball), and the others answered correctly. In the case of squares, we did not have the correct answers. Everyone said it was a cube. In the case of the triangle, half of the children answered correctly, and the rest said: circle, rectangle, Christmas tree. In the fourth group, which has had questions related to the triangle so far, almost everyone answered correctly, and one child refused to continue further conversation. From the wrong answers, we had: a cube and that they do not know. In the case of the circle, we had most of the correct answers. From the wrong ones we had: ball, cube. In the case of squares, we had two correct answers. Other answers were: cube, square, triangle. In the case of the rectangle, we had one correct answer. Other answers were: square, cube, triangle, picture, line. Thus, in the task in which we summarized the previous tasks, we noticed that each group had certain difficulties in identifying and naming the given figures.

Conclusion

After conducting a case study on the identification and naming of given figures, we noticed that children of kindergarten age

still have certain difficulties to do such tasks. After analyzing all the answers and comparing them, we noticed an inconsistency in the answers. It happened that in one task the child named a figure correctly and in another not. We also noticed that the child's age was not correlated with the wrong answers, i.e. we did not have a higher percentage of wrong answers in three-year-olds compared to older children. We also concluded that the children who were part of this case study did not notice a connection between the square and the rectangle. When they compared them, they talked about them as completely different figures. If we compare the results we obtained in this research with the results of a similar research, but in the case of three-dimensional geometric figures in which it was proved that children most often made mistakes by listing two-dimensional figures instead of three-dimensional ones (Nesimović, 2021), we reaffirmed that kindergarten children did not adopt the concepts of two-dimensional figures. We believe that the results we have obtained are very significant because they indicate that even more work should be done with children on such and similar tasks. Special attention should be paid to the natural environment in which activities with children will be realized, and all concepts should be connected with situations from everyday life where these concepts meet.

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