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Investigating Pre-School Children's Perspectives of Robots through Their Robot Drawings[1]

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Abstract

This study investigated preschool children's opinions on educational robots using their robot drawings. The study group consisted of 64 five- and six-years old children in an independent kindergarden affiliated to the Ministry of National Education (MoNE) in Ankara province, Turkey and participated in the Preschool Robotics Coding Workshop within the scope of the project titled "TUBITAK 4007 Science in the Footsteps of Cezeri" in the 2018-2019 academic year. For the purpose of this study phenomenology model as a qualitative research approach was adopted and data was collected through visual materials and semi-structured interviews to determine children's opinions on robots. The data collection process was carried out in an eight-weeks period starting in March 2019 as one week for the acquaintance phase, six weeks for practice, and the last week for a two-day workshop with educational robots. In line with the findings of this research, the mechanical features of the robots were examined, it was determined that there was an increase in the battery drawings in children's last drawings compared to their first drawings. It was also determined that the children responded to "Who builds the robots?" interview question as factories, scientists, machines, and repairers in the first interview while more than 90% of the children responded as scientists and engineers in the second interview.

Keywords: Child drawings, educational robot, preschool children, robot drawings, coding

1. Introduction

Painting art is a type of creative activity for expressing thoughts, goals, phenomena, and events using imagination and transferring them to others (Lowenfeld, 1971). Children can also transfer many thoughts that they cannot verbally express through drawing pictures. These drawings, which appear as unconscious scribbles in the early periods, gain meaning over time. These meaningful drawings provide clues to the child's exploration of the world (İskenderoğlu, 2006; Metin & Aral, 2012). When the related literature is examined, it is seen that the development

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[1] This article was produced from TUBITAK 4007 Science in the Footsteps of Cezeri Project.

stage of drawing in childhood is divided into five stages. These stages are: Scribble Stage (2 to 4 years), Preschematic Stage (4 to 7 years), Schematic stage (7 to 9 years), Dawning Realism Stage (9 to 11 years), and the Pseudorealistic Stage (12 to 14 years) (Lowenfeld, 1971).

In the Preschematic Stage covering the 4 to 7 years and including the preschool education period after the scribble stage, it is emphasized that it is important to examine the pictures of children as they are important in terms of their drawing development. When the characteristics of this stage are examined, it is understood that the children start to use symbols in this stage. The child can transfer the reflection of the objects he/she encounters in his/her daily life to his/her drawings by using different materials (Gürtuna, 2004; Malchiodi, 2005; Metin & Aral, 2012).

According to the previous study, the images seen in children's drawings are important data resources about them, but they are not sufficient alone (Ersoy & Türkkan, 2009), and therefore the data obtained from the literature emphasize the necessity for using interviews to support children's drawings. Helping children who have difficulties in expressing themselves talk about their drawings is effective in triggering their memory and recalling more memories and information (Sayıl, 2004). Based on this information, it can be inferred that children can express their feelings and experiences more clearly in their drawings.

2. The Study

2.1. Aim and Significance of the Study

This study aims to investigate the robot drawings of five-six years old children and their opinions on educational robots in the world surrounded by technology. While there were studies which focused on the use of education robots in education, there were no studies investigated the opinions of children on educational robots. According to the previous research, people live in a world surrounded by technology (Bers, 2008). From the pen we use to the phone, to the computer and camera, the objects around us change and evolve with the technology. For example, the tap automatically opens when we want to wash our hands, elevator door does not close even if there is a small object in the doorway, our phones know how to send electronic mails, and what time it should wake us up (Bers & Horn, 2010). The new generation, which was born in the 21st century and grew with the power to control and develop all these objects, is called "the digital natives" because of their proximity and predisposition to the digital world (Prensky, 2001).

One of the tools used as educational materials in the classes are educational robots. These robots used in the educational process are preferred as they give immediate feedback about the targeted concept and are found interesting by the children. If the interest levels of the students are high, their motivation and desire to learn also increase (Resnick, 2003). However, there are some difficulties in using educational robots in the training process. Teachers' not having sufficient knowledge and experience in this regard, and teacher training programs' not training the teacher candidates with a vision of following technological developments are some of these difficulties (Bers et all., 2002; Kasalak, 2017). According to the research, it is necessary to increase the number of studies to be carried out on this subject and to provide in-service training opportunities for teachers to include educational robots in education programs (Ioannidou, et all., 2011; Johnson, 2003).

In addition to the use of educational robots in education as a part of 21st-century skills, it is also very important to provide coding skills for children. Despite all these, it was revealed as a result of the research that many teachers working in the field had little experience on this subject and some teachers had almost no experience. It was also mentioned that the programs which train preschool teachers do not train teacher candidates with a vision of following technological developments. It is considered that this situation causes preschool teachers to choose the role of a teacher who consumes technology rather than choosing the role of a teacher who designs a technologically enriched program (Bers et all., 2002). In addition to this, it was also mentioned in the related literature that the coding process is an abstract concept, it could be objectified for the children by dramatization activities, and the lack of dramatization activities constituted a problem situation (Odacı & Uzun, 2017). In light of the findings obtained from this study, the studies to be carried out on coding training in the preschool period should objectify the coding process through dramatization and minimize the disadvantage of children being illiterate by using visual materials. When teachers and students recognize the educational robots, they can use in robotics coding and perform activities in the classes with these materials, the interest and motivation of students will increase and teachers' hesitation about using materials will disappear.

This study aims at determining the opinions of children born in a technological world on the educational robots used in the classes. This study is significant in terms of serving as a model for similar studies, increasing the usage competencies and motivations of preschool teachers to use educational robots to enrich their educational statuses, considering the opinions of children in robot designs by the ones working in the field of educational robot design, and contributing to the relevant literature.

1. How are the perceptions of children about educational robots?
2. How are the educational robot experiences of children?
3. What is the difference between the first and last drawings of children?
4. Which activity was most liked by the children?

This research aims to find answers to these questions. Determining children's perceptions of robots will be useful for designers who design robots. It will also give teachers an idea about choosing an educational robot that they plan to use in the classroom. Determining the educational robot experiences of children in the learning process will help to prevent problems that may occur in the teaching process that will be planned in the future. It will enable teachers to have an idea about children's views and to take precautions against problems that may occur in the learning and experiencing process of educational robots. Examining the differences between the first and last drawings of children is an opportunity to examine the impact of the educational robot experience process on them in a detail way. It is thought that investigating the most liked activity of children is necessary in terms of forming a basis for teachers' activity planning and choices. It will show teachers how educational robot experience is from children's eyes. This research will enable teachers to gain insight into children's educational robot experiences, perspectives, and drawings. In addition to this, it will contribute to the literature on educational robot design, educational robot activities and children's drawings.

2.2. Relevant Scholarship

Examining the drawings of children has been the choice of many scientists with expertise in different fields. It is understood from the literature that the drawings of children have been adopted as research subjects in different subject fields. In this regard, some of the studies encountered during the literature review are as follows: Studies for determining the perceptions of children towards the concept related to the world and daily life (Klein, 1982; Ehrlen, 2009; Chang, 2012); studies for determining the relationships between children's emotional development and mother drawings (Cox & Moore, 1994; Çakmak & Darıca, 2012); studies for determining the emotional states of children based on the sizes, colors, and facial expressions of the figures drawn by the children (Beck& Feldman, 1989; Burkitt, Barret & Davis, 2009); studies for determining the scientist image in children's mind (Buldu, 2006); studies for determining the scientist perceptions of children (Güler & Akman, 2006); studies for determining children's perceptions about environmental problems (Barraza, 1999; Sadık, Çakan & Artut, 2011); studies for revealing the mathematics teacher images of primary school students (Picker & Berry, 2000); studies for determining how the concept of health is perceived by children (Rijey & Van Rooy, 2007); studies examining mythological drawings (Pehlivan, 2008); studies for determining the first sacred ceremony perceptions of children (Stokrocki &Kırışoğlu, 1996), and studies on family life (Türkkan, 2004) are some of the studies aimed at explaining a particular event, phenomenon, or object based on the drawings of children. When the national literature was reviewed, it was seen that there was no comprehensive study on children's robot drawings. When international literature was reviewed, it was seen that a study was carried out to examine children's opinions and drawings. In that study, children were asked to examine the robot drawings (Woods & Joerg, 2004).

2.3. Method

This section includes information about the study group, data collection tools, data collection process, and data analysis.

This research has been designed according to the phenomenology model, one of the qualitative research approaches. Phenomenology model is used to explain the common meaning of phenomenon or concept one or more people's experiences (Creswell, 2013). Phenomenology focuses on how people perceive phenomena, how they describe them, how they feel about it, how they judge and remember them, how they make sense, and how they talk to others about it (Patton, 2014). Phenomenological studies focus entirely on individual perceptions and try to investigate the experience from the perspective of the "inside" (Tanyaş, 2014). In this study, investigating pre-school children's perspectives of robots through their robot drawings were determined as a phenomenon. The visual data obtained from children's drawing was analyzed through document review while the interview forms were analyzed through descriptive analysis.

2.4. Sample

The criteria sampling method was used in this study. In this regard, the determined criteria were as follows: continuing four different age groups in an independent kindergarten affiliated to the MoNE in Etimesgut district of Ankara province, Turkey, being in the range of 48 to 72 months old and attending the Preschool Robotics Coding Workshop within the scope of the project titled "TUBITAK 4007 Science in the Footsteps of Cezeri". The study group of this study included 43 male children and 21 female children (total of 64). The frequency distributions of the ages and genders of children in the study group according to the classes were presented in Table 1. In this regard, the classes in the independent kindergarten were coded as "Class A, B, C, and D" in Table 1.

Table 1. Sample

Child Properties		**Class A**	**Class B**	**Class C**	**Class D**	**Total**
Age	48 to 60 months old	9	9	9	7	**34**
	60 to 72 months old	8	5	10	7	**30**
Gender	Female	7	4	7	3	**21**
	Male	10	10	12	11	**43**

2.5. Data Collection Tools

Visual materials and semi-structured interview forms were used as data collection tools to determine children's opinions on educational robots. Visual materials are one of the qualitative data collection tools. They offer participants the opportunity to directly share their facts (Creswell, 2013). The visual materials in the research process consist of robot drawings drawn by the children participating in this study. In this study carried out within the scope of the "TUBITAK 4007 Science in the Footsteps of Cezeri" project, data were collected through children's drawings and semi-structured interview forms developed by the researchers. Information about how the data collection tools used in this study are created and how they are used in the research process are provided below.

2.5.1. Robot Drawing of Children

When the drawings of children are analyzed well, making drawings help to reveal the cognitive structures clearly even if the concepts investigated are complex and it is effective in revealing the schemes existing in the minds of children and their relationships with other schemes (Schafer, 2012). Therefore, the data were collected from the drawings made by children, and the expressions of children were noted behind these drawings by interviewing with each child about their drawings. In many studies carried out in the literature on drawing analysis, the uncertainty of the drawings of the preschool children revealed the need for verbal explanations when analyzing their drawings. Therefore, the opinions of children on the subject were also collected along with their drawings as data. Data regarding children's drawings were collected in two stages. In the first meeting after the acquaintance phase, the children in the four classes of the independent kindergarten were requested to make a robot drawing. After the educational practices were performed with the robots one hour a week, they were finally requested to make another robot drawing. The symbols that children included in their drawings and the messages and stories they wanted to tell by using these symbols were noted behind the drawings.

2.5.2. Semi-structured interviews

After the semi-structured interview form was developed by the researchers, it was reorganized and finalized by taking the opinions of three experts. Considering these three experts, one expert was from the child development and education field, one expert was from the preschool education field, and one expert was from the assessment and evaluation field. There were a total of nine questions in the semi-structured interview form. In the first meeting with the children during the interviews within the scope of this study, the following questions were asked: “What is a robot?”, “Have you ever seen a robot?”, “What do robots do?”, “How do robots work?”, “Who makes the robots?”, “If you were a robot, what kind of robot would you be?”, “Why would you want to be that robot?”, “What do you need to make a robot that does what you want?”, and “What is robotics coding activity?”. At the end of six-week educational practices, a final interview was made using the same interview questions. The answers provided by the children regarding the interview questions were recorded on the child interview form. The first interview form consisted of nine questions while the second interview form consisted of 11 questions. The additional questions in the second interview form were as follows: “Which activity did you like the most?” and “Why?”.

2.6. Data Collection Process

The legal permissions to conduct the study in an independent kindergarten were obtained from the Ministry of National Education, Turkey. In addition to this, the institutional permissions received from Hacettepe University and TUBITAK within the scope of “TUBITAK 4007 Science in the Footsteps of Cezeri” project were completed, and consent forms were obtained from both children and their parents since the participants of the study were under the age of 18. The data were collected in March and April months of the 2018-2019 academic year. The data collection process was carried out in an eight-week period starting in March 2018 as one week for the acquaintance phase with children and teachers, six weeks for practice, and the last week for a two-day workshop with educational robots. The data collection process was completed in four stages (Figure 1).

The activities were planned by the researchers. Before the activities were planned, a total of 4 field experts were interviewed, 1 expert in preschool program, 2 experts in robotics coding, 1 expert in child development. After these interviews, the researchers decided on the activities they would implement and the educational robots they would use. In addition to this, it was thought that it would be beneficial to use different educational robots during the education process.

In the first stage, before performing activities with the children in the first week, they were requested to make a robot drawing and their short stories were noted behind their drawings. Then, the first interview was held to determine their opinions on robots. Next, various activities were performed with educational robots in the classes for six weeks. The activities were performed by using educational robots that do not require a computer or any installation as much as possible. During these activities, mobile coding mats (carpets) consisting of 4 different robots and obstacles with functions from simple to the complex were used. When performing these activities, the children guessed how many steps would be needed for the robots to reach from the starting point to the endpoint without hitting the obstacles and they affixed the pre-prepared arrow signs on the path the robot would go on the coding ground. Then, they pressed the start button by using the robot’s remote-control unit and moved the robot from the starting point to the end point by moving forward, backward, right, and left on the coding ground. After performing educational activities with children for seven weeks, the science festival was completed by performing preschool robotics coding activities with the children within the scope of “TUBITAK 4007 Science in the Footsteps of Cezeri” project in the last week. In the second stage, the children were asked to make a robot drawing for the second time and then, the second interviews about robots were held after completing the science festival titled “TUBITAK 4007 Science in the Footsteps of Cezeri”.

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Figure 1. The Steps Followed During the Project Process

First step: Gathering the first robot drawing of children and interviewing with children about robots and activities

Second Step: Performing various activities with educational robots for six weeks

Third Step: Children perform their activities in festival area

Last Step: Gathering the last robot drawing and interviewing with children about robots and activities

2.7. Studies Performed within the Scope of "TUBITAK 4007 Science in the Footsteps of Cezeri" Project

After making acquaintance with the teachers and children in the first week, the teacher training process was started. Within the scope of workshop works, information forms to be sent to the parents and teachers and voluntary participation consent forms were sent to the parents who wanted their children to participate in the study, and forms were retrieved. Then, parent volunteer participation approval/permission forms regarding the volunteer participation of their children in robotics coding activities and workshops were sent to parents. Before continuing with the use of educational robots for the first three weeks, games with position in space theme were played to reinforce the concepts of forward, backward, right, and left with the children. In this regard, some of the games played were as follows: A game in which a child directs an adult, who has a robot role, by giving commands such as turn right, two steps forward, turn left, two steps backward, etc., a game in which children with the role of an adult direct other children as if they were robots, and a game in which a child, who is "It", directs the other child to draw the pattern on the canvas by telling the instructions on the worksheet without showing it to the other child. In the following weeks, practices regarding the activities to be performed in the workshop and the use of four different educational robots (BeeBot, Evaluation, DocRobot, Bootly) were organized for the children and teachers, and the activities were performed. With the activities performed, it was aimed for children to acquire necessary skills such as matching, ranking, position in space, positional language, direction language, problem-solving, and being able to give directions before the robotics coding workshop to be carried out within the scope of "TUBITAK 4007 Science in the Footsteps of Cezeri" project. In this regard, it was aimed to objectify the coding process through games by using visual materials, educational robots, and different teaching methods and techniques before coding works. In addition to this, it was also aimed for children to internalize problem-solving, critical thinking, and algorithmic thinking. During the activities, particular importance was given for children to enjoy the activities. Thus, it was aimed that children would develop a positive attitude towards technology and science. In the six-week period in which the activities were performed, paper activities for improving the coding skills that children could do with their parents at home were sent to the parents as a family participation study. As in the ideal model that should be in preschool education quality standards, these activities were performed in cooperation with children, families, educators, and school administrators. After performing educational activities with children for seven weeks, preschool robotics coding activities were performed in the last week of project.

2.8. Data Analysis

The visual data obtained from the robot drawings of children were analyzed through the document review technique from qualitative research data analysis techniques and the data obtained from the interview forms were analyzed through a descriptive analysis technique. The document review is defined as the examination of all data at the macro and micro levels such as any document, image, or sound recording (Yıldırım & Şimşek, 2016). Descriptive analysis is a type of qualitative data analysis that includes summarizing and interpreting the data obtained through various data collection techniques according to the predetermined themes (Özdemir, 2010). In this regard, some themes were determined by considering the topics in the interview form. The questions in the semi-structured interview form were considered as themes in the descriptive analysis. The visual data obtained from the drawings were analyzed through the document review technique. The themes obtained from the document review technique were presented in Appendix 1. The drawings not included in the themes were added as themes later. To increase the reliability of the study and to ensure inter-coder consistency among the researchers, 10 independently selected drawings were coded separately by the researchers. The correlation coefficient was examined by considering the coding of both researchers. The correlation coefficient in the analyzed 10 drawings was found to be .98 ($p<0.001$) and it was determined that the consistency between the researchers was high. Achieving internal validity in qualitative research is ensured by eliminating the subjective perception of the researcher and examining the research subject as objectively as possible (Yıldırım & Şimşek, 2016).

3. Results

3.1. Findings and Interpretations

This section includes findings obtained from the children's first and last robot drawings and findings obtained from the first and last interviews. The findings considering the children's first and last drawings included the distribution graphics of the parts of the robot body, the line features used in the drawing, the colors used, the robot appearance feature, the robot emotion drawings, mechanical features of the robot, the shapes they used in the drawings, the availability of features for the things the robot does, and the way robots work.

In this part, it was stated which subtitle was examined. Then, the table of the examined title is included. After the table explanation, striking pictures of the children about the title were placed. For example, the first subhead is body parts. The situation of drawing the body parts in the first and last drawings of the children was shown with a table. After that the table explained. Then, sample pictures were added.

3.1.1. Findings Related to Children's Drawings: Body Parts

In the graphic in Table 2, it is seen that there is no remarkable difference between the children's first drawings and last drawings considering the body parts such as the body, arms, legs, head, neck, and feet. It can be inferred from this graphic that children generally attributed human features to the robots. When the sensor drawings between the first and last drawings were examined, it was seen that the number of eye and mouth drawings increased. Road maps used for children to find the paths of the robots they experienced with both the researchers and their teachers for six weeks were thought to cause children to think that robots had vision sensors. The fact that the robots used in the research process had speech characteristics can be associated with the increase in the mouth drawings in children's final drawings. In addition to this, it was seen that the first drawings did not include ears or similar organs related to hearing sensors while some drawings included hearing sensors. The fact that some robots used in this study had voice detection and voice command features can be associated with this finding. When the dimensions of the robot drawings were examined, it was seen that large and medium dimensions were the majority and small dimensions were the minority in the first drawings. Considering the last drawings, it was seen that the number of robots drawn with small dimensions decreased. In other words, it was observed that the robot dimension drawings enlarged with the educational process received.

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Table 2. The distribution graphics of robot body parts in children's first and last drawings

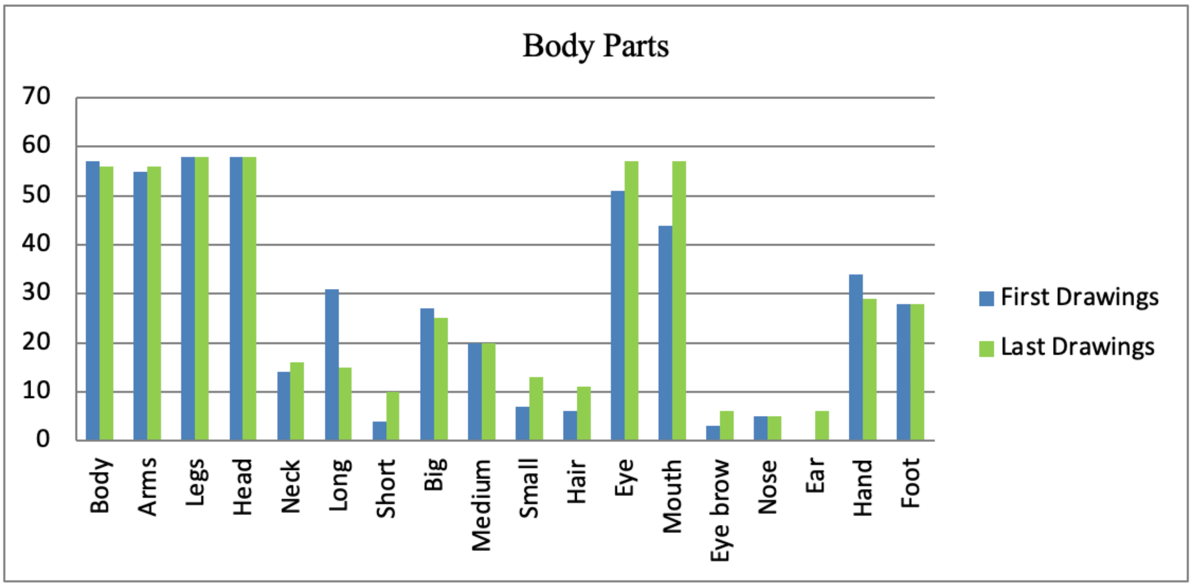


Figure 2. Drawing realized by a 5-year-old boy

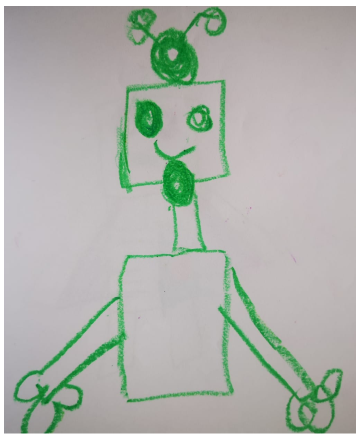


Figure 3. Drawing realized by a 4-year-old boy

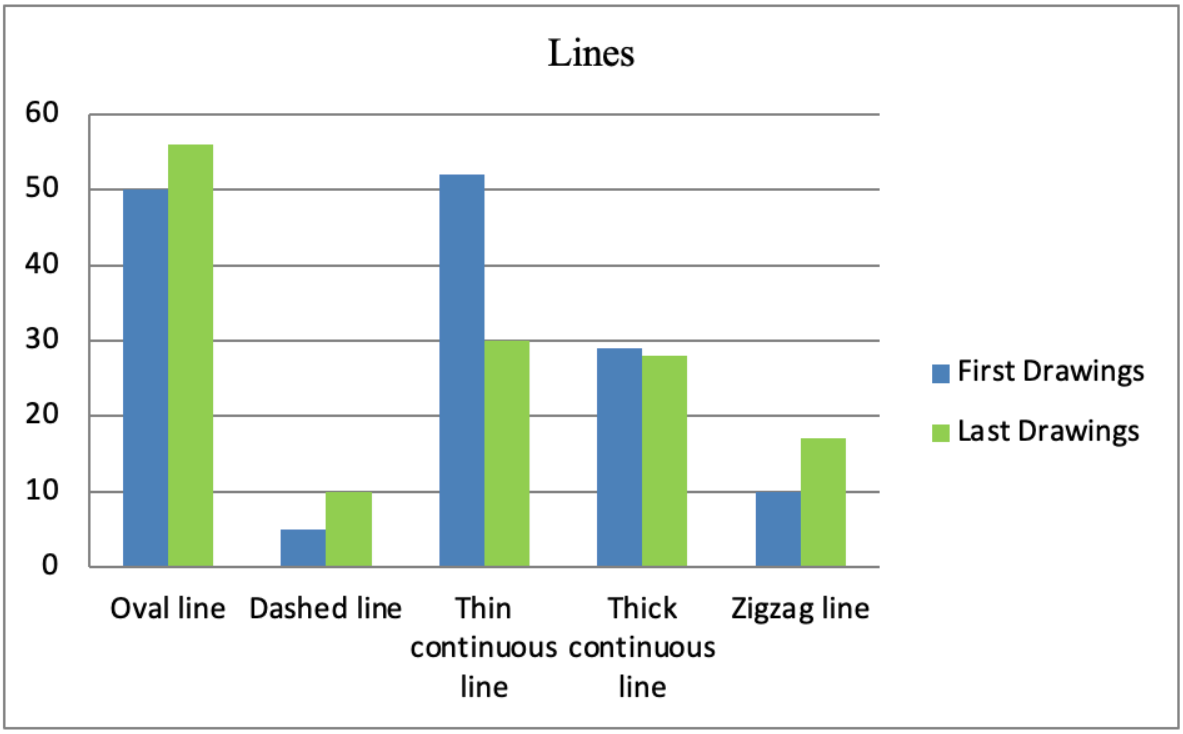
Figure 4. Drawing realized by a 5-year-old girl

*Figure 2-3-4 are placed to show how children expressed the body parts of robots in their drawings.

3.1.2. Findings Related to Children's Drawings: Lines

As can be seen in Table 3, the lines used in children's robot drawings consist mostly of oval lines, thin continuous lines, and thick continuous lines respectively. It can be inferred from the table that oval lines were used to draw the head of the robot rather than other parts of the body, and thin and thick lines were mostly used in the body parts. It was determined that the use of zigzag lines increased in the last drawings.

Table 3. The distribution graphics of the **lines** used in children's first and last drawings



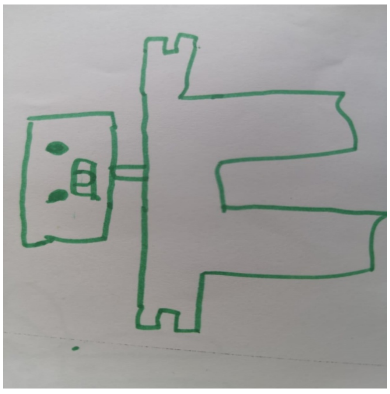


Figure 5. Drawing realized by a 4-year-old girl

Figure 6. Drawing realized by a 5-year-old boy

*Figure 5-6 are placed to show which lines were used by children while drawing a robot.

3.1.3. Findings Related to Children's Drawings: Colors

When the colors used in the drawings were examined, it was seen in Table 4 that red, blue, green, purple, and orange colors were used frequently. It was seen that, in general, children used colors in their robot drawings.

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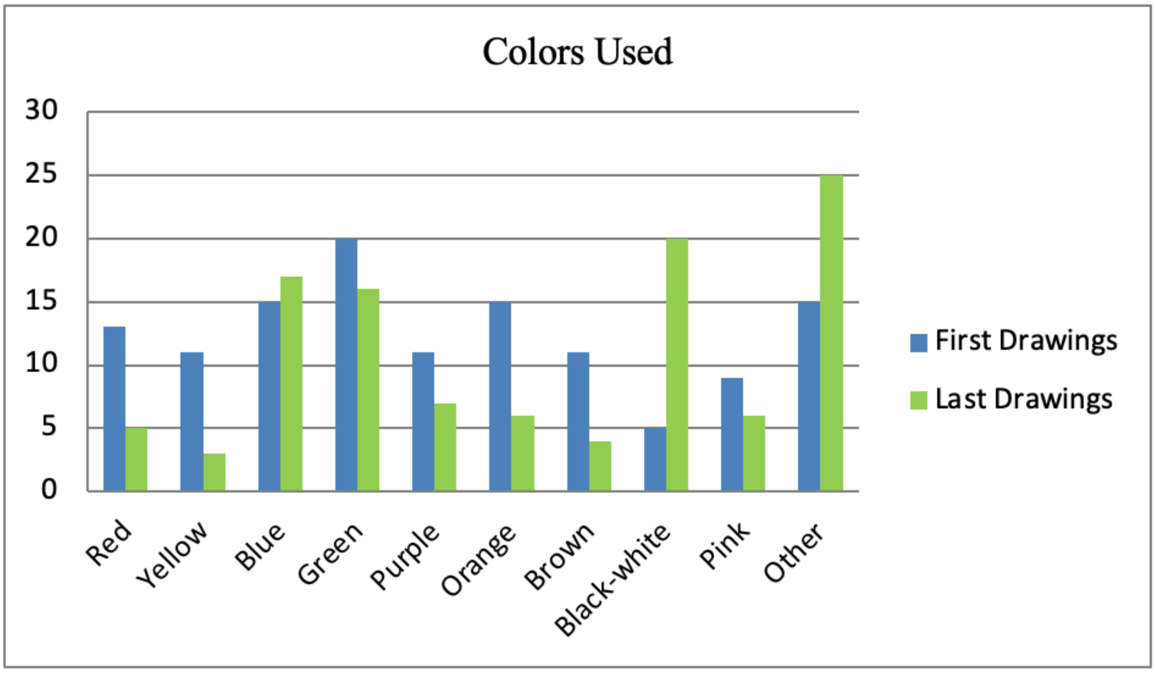
Table 4. The distribution graphics of the **colors** used in children's first and last drawings



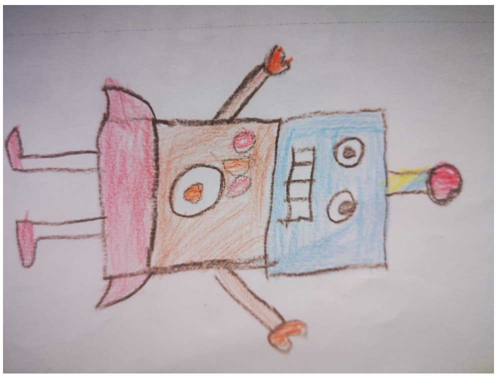


Figure 7. Drawing realized by a 6-year-old girl

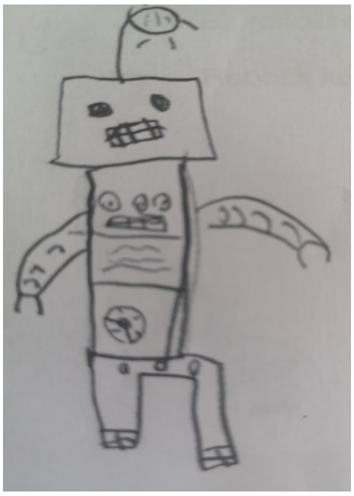


Figure 8. Drawing realized by a 6-year-old boy

*Figure 7-8 are placed to show which colors were used by children while drawing a robot.

3.1.4. Findings Related to Children's Drawings: Robot Appearance

In the first drawings, it was concluded that the number of drawings with metallic features was lower than the colored drawings as it can be seen in Table 5. In the last drawings, it was observed that the number of drawings with metallic features increased. The reason for this is thought to be the fact that the most functional one of the robots used as educational robots had metallic features. It can be interpreted that the robot named Evaluation attracts children's attention more and adopts more typical stereotypical features compared to other robots.

Table 5. The distribution graphics of the **robot appearance feature** in children's first and last drawings

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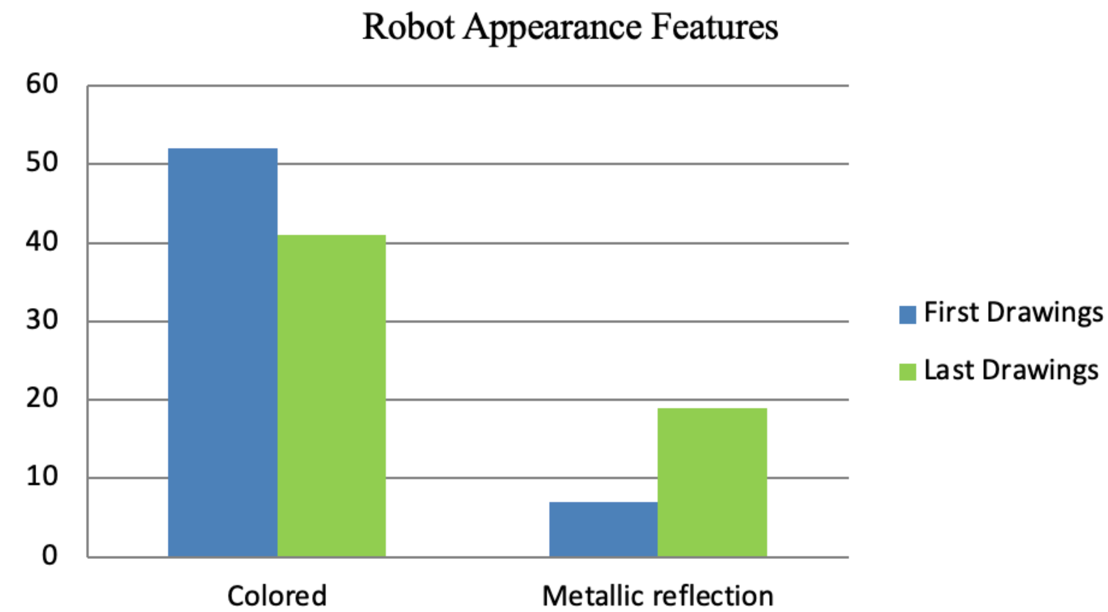

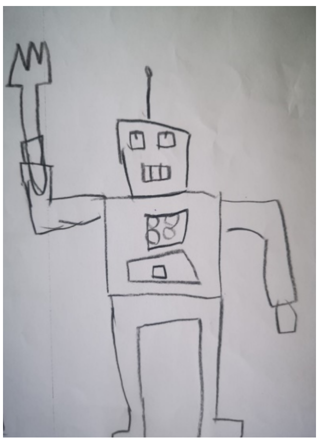

Figure 9. Drawing realized by a 5-year-old boy

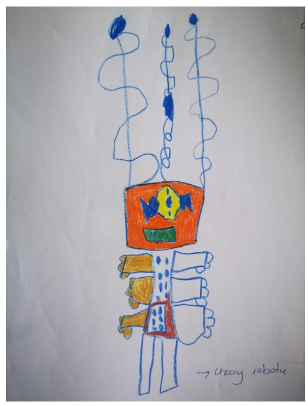

Figure 10. Drawing realized by a 5-year-old boy

*Figure 9-10 are placed to show how children expressed the robot appearance in their drawings.

3.1.5. Findings Related to Children's Drawings: Emotional State

In the robot drawings of children, emotional states of the robots were determined based on the facial expressions of the robots. With regards to the first drawings, it was concluded that happy and expressionless emotional states were in the majority as it can be seen in the Table 6. With regards to the last drawings, it was determined that the number of happy and expressionless drawings decreased while the number of angry, confused, and unhappy drawings increased.

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Table 6. The distribution graphics of the **robot' emotional state** drawings in children's first and last drawings

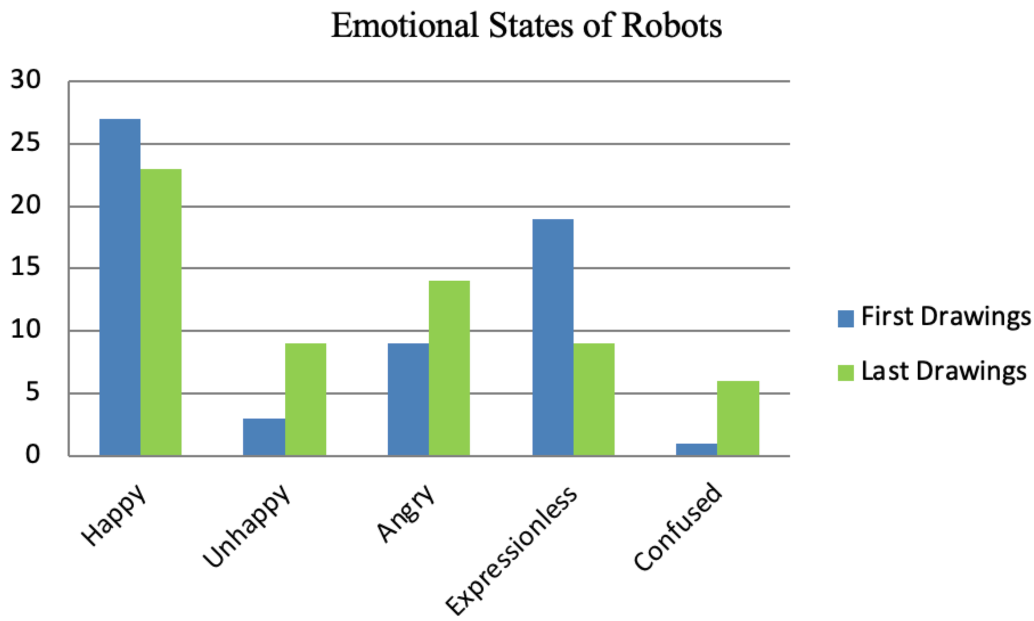

Figure 11. Drawing realized by a 6-year-old girl

Figure 12. Drawing realized by a 5-year-old girl

*Figure 11-12 are placed to show how children expressed the robot's emotional state in their drawings.

3.1.6. Findings Related to Children's Drawings: Mechanic Features

When the mechanical features of the robots were examined, it was seen that there was an increase in the battery drawings in the last drawings compared to the first drawings. It was considered by the researchers that briefly mentioning the key information about how robots work during the education provided for children was effective in this case.

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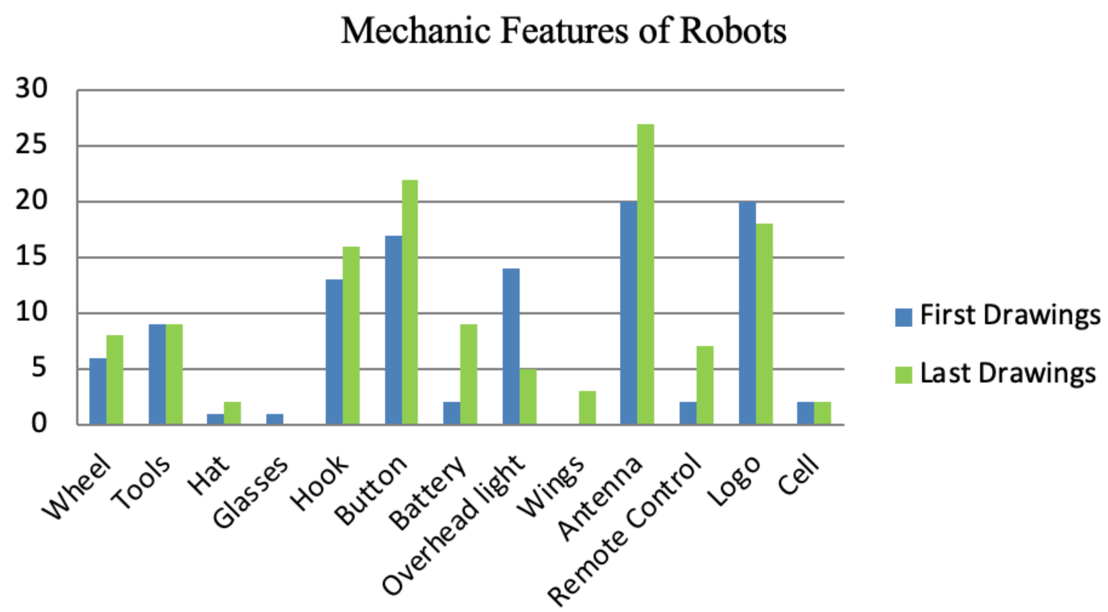
Table 7. The distribution graphics of the **mechanic features** of the robots in children's first and last drawings



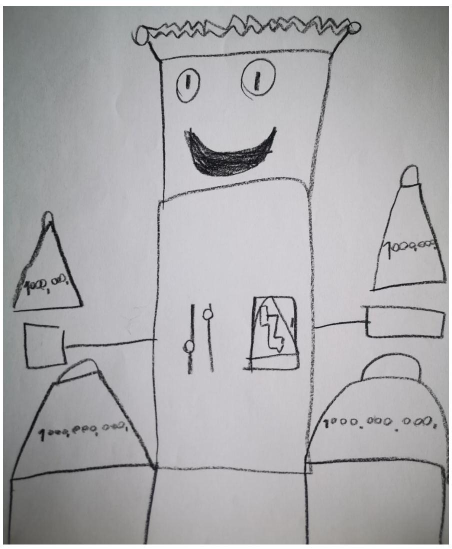


Figure 13. Drawing realized by a 6-year-old boy

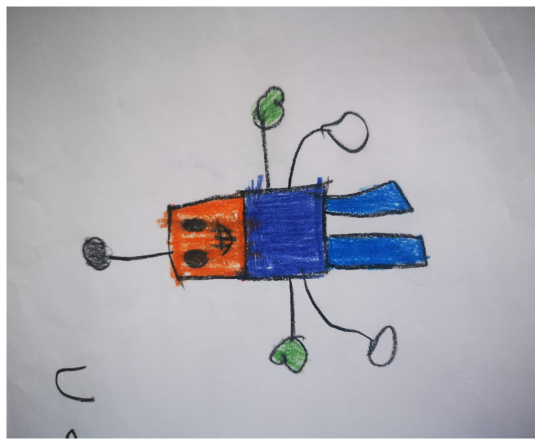


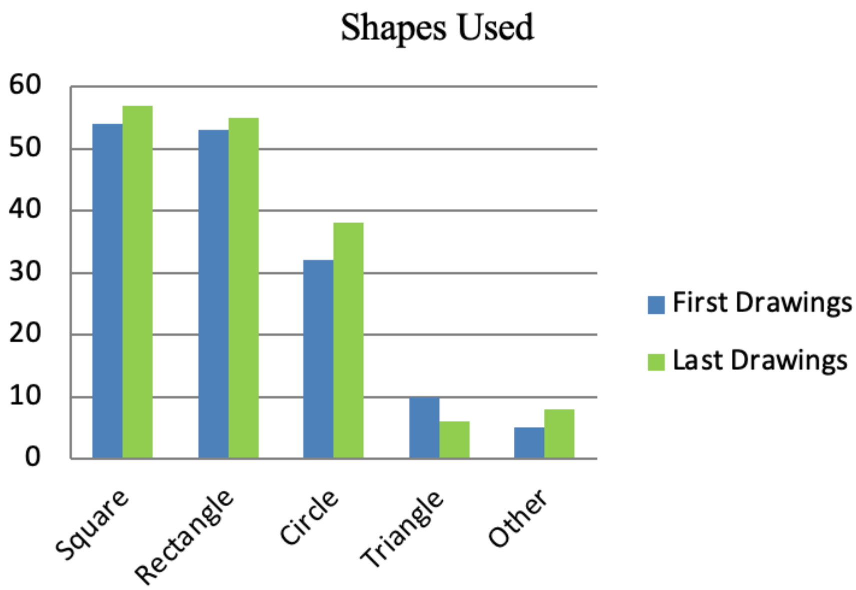
Figure 14. Drawing realized by a 5-year-old girl

*Figure 13-14 are placed to show which mechanic features were used by children while drawing a robot.

3.1.7. Findings Related to Children's Drawings: Shapes

When the robot drawings of children were examined, it was striking that they mostly used square and rectangular shapes. There were no remarkable differences between the children's first drawings before the educational activities and the last drawings.

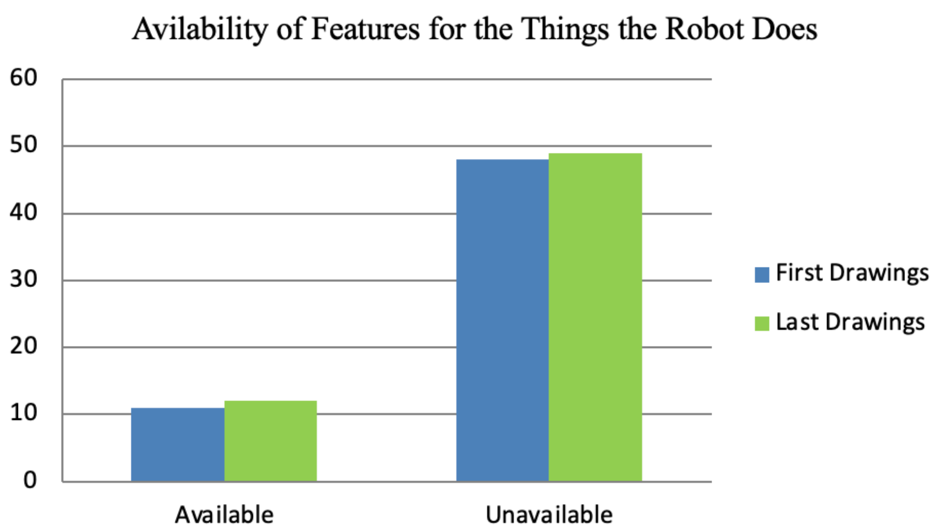
Table 8. The distribution graphics of the **shapes** children used in their first and last drawings



3.1.8. Findings Related to Children's Drawings: The Availability of Features for the Things the Robot Does

Considering the availability of features for the job the robot does, it was inferred that there were no remarkable differences between the children's first drawings and the last drawings as it can be seen in the Table 9. It was determined from the data that the robots mostly didn't have features for the things they did.

Table 9. The distribution graphics of **the availability of features for the things the robot does** in children's first and last drawings



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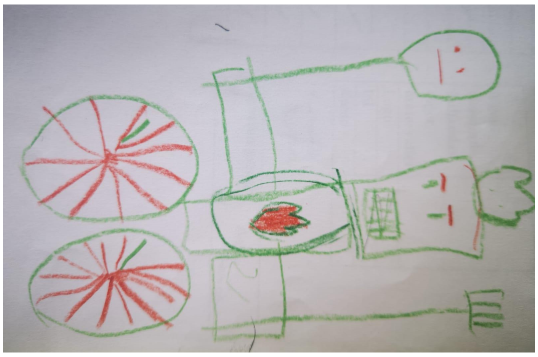


Figure 15. Drawing realized by a 6-year-old girl

*Figure 15 is placed to show the availability of features for the things the robot does in children's drawings.

3.1.9. Findings Related to Children's Drawings: Working Way

Considering the way robots work in children's drawings, it was determined that robots mostly worked individually. There was no remarkable difference between the children's first and last drawings as it can be seen in the Table 10. It was considered that children included individually working robots in their robot drawings because they were unable to experience robots working as a group.

Table 10. The distribution graphics of how **the way robots work** in children's first and last drawings

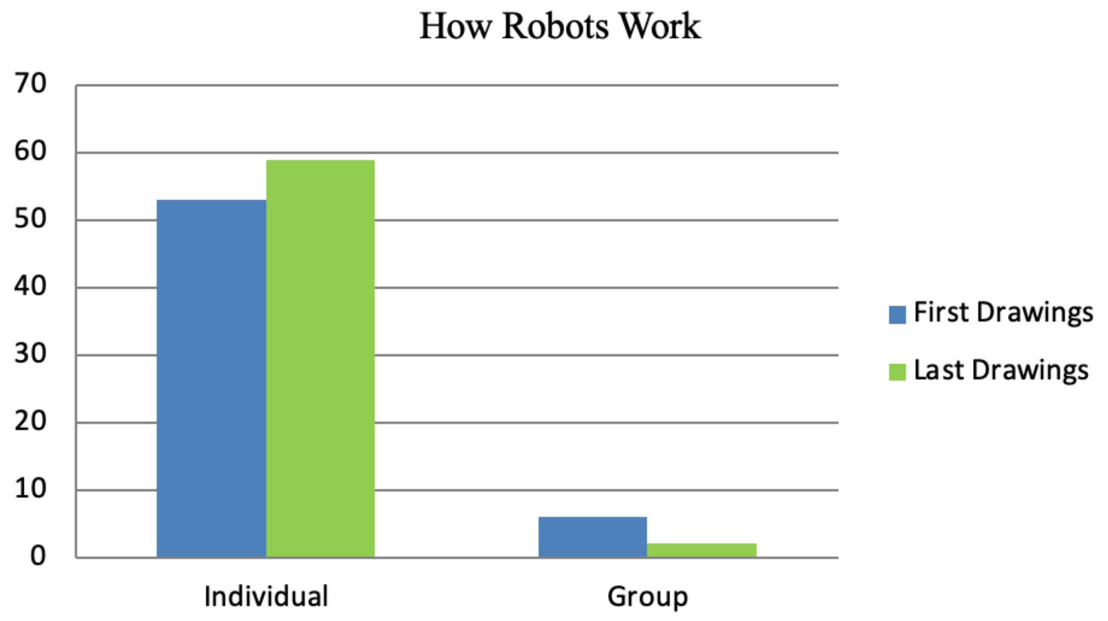


Figure 15. Drawing realized by a 4-year-old girl

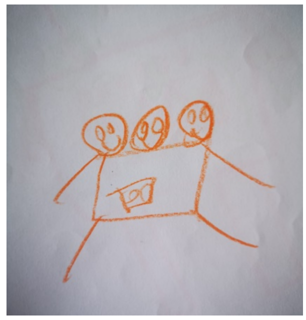


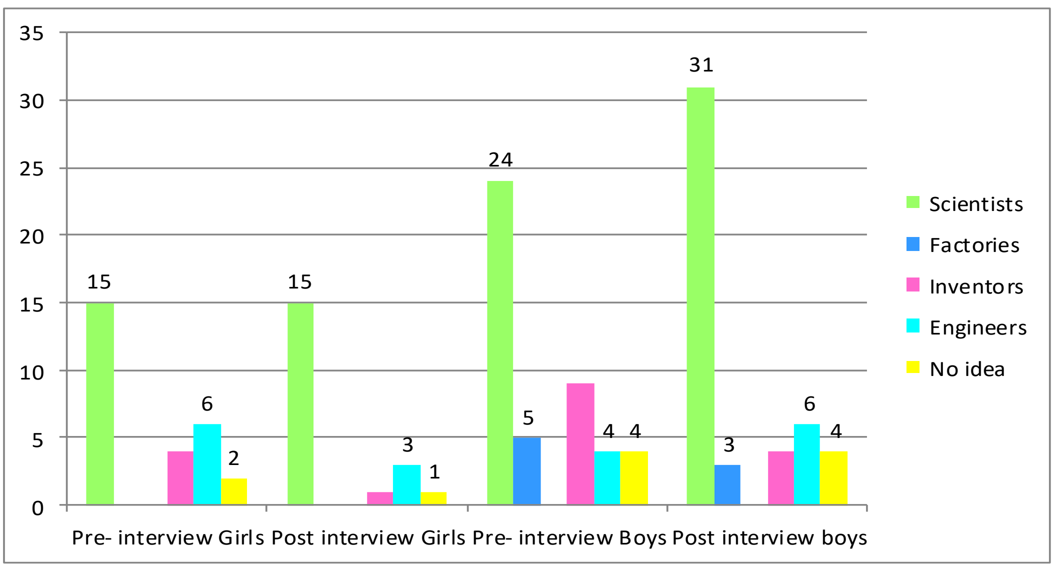
Figure 16. Drawing realized by a 5-year-old boy

*Figure 15-16 are placed to show how robots work in children's drawings.

3.1.10. Findings Related to the Interviews with Children

The first finding is that children internalized the concept of scientist. In Turkish language there is a difference between scientist and man of a science. In the first interview children called scientist with their gender which is man of science. However, children internalized the scientist concept after this educational process. While this was not one of the aims of the research, it was one of the exciting results for the researchers. It was determined that the children responded to "Who builds the robots?" interview question. The answers of the children were examined under 4 headings which are scientist, factories, inventors, engineers, no idea. Intelligent people, hardworking people, professors' answers are combined under the title of scientists. Robots, factories responses are combined under the heading of factories. Inventors, discoverers answers are combined under the title of inventors. The answers of masters, engineers, repairmen are combined under the title of engineers. This finding supports the assumption that the workshops held promoted the development of the concept of scientist in children.

Figure 17: The distribution graphics of the answer to the question *"Who builds the robots?"*



It was observed that the children participating in this study obtained information about how robots worked, who designed robots, how they were made, and the algorithmic and electronic system behind the operation of the robots thanks to this science festival. Another striking result obtained from the pre-test and post-test interviews was the information that most of the children had never seen a robot before. The quotations obtained from the responses of children were included in this study by coding C1, C2, C3, etc. Most of the children responded to the question of "Have you ever seen a robot?" as "No, I haven't seen" while one of the children provided the following response:

C3: "...I have seen it on TV..."

To conclude, most of the children stated that they saw a robot for the first time during the activities performed within the scope of the project.

Considering the question of "What is a robot?" in the first interviews.

C25 responded: "...It is something made of iron..."

C31 responded: "...It is a helper..."

C18 responded: "...It is something like a human..." Considering the same question in the last interviews.

C2 responded: "...Artificial intelligence..."

C34 responded: "...It is something that operates with electricity..."

C9 responded: "...A device made of electronic devices..."

When the responses given by the children for this question were examined, it was inferred that they had basic information on the term of artificial intelligence and the concept of electricity through which they got an idea of the operating principles of robots.

In addition to this, it was also determined that the children learned conductor and insulator terms, the distinction between these terms, and the concepts regarding the direction language such as "forward, backward, right, and left". The use of different learning methods and techniques with activities such as experiments, dance, STEM, art, plays, and family involvement in robotics coding workshop process is considered to improve high-level thinking skills such as problem-solving, predicting, reasoning, critical thinking, and finding creative solutions for the questions asked.

When the question of "Which activity did you like the most?" was asked to the children in the second interview, it was determined that they provided various responses. Some of the responses were as follows:

C5: "...I liked the Doc most..."

C1: "...BeeBot..." and

C43: "... The activity in which one of us described and the other drew..."

Based on this information, it can be inferred that performing activities with educational robots using various learning methods and techniques will provide permanence and significance in learning.

Considering the question of "Which activity did you like the most? Why?", some of the responses of children were as follows:

C3: "...I like it..."

C32: "... Because it is so entertaining..."

C60: "... It is so big, and this is the first time I saw it..."

C17: "... There is music coming out of it, interesting..."

The data obtained from the responses of children suggest that keeping children in the foreground of their permanent learning by having fun when planning activities supports this situation. It was observed by the researchers that the children attending the workshops increased their motivation in the process of getting robotics coding training and participating in the activities. Some of the children provided the following responses.

C2 responded: "... I learned right, left, back, and front terms..."

C45: "... I learned the directions..."

C63: "... I learned the directions and it was so good..."

Considering these responses of children, it can be inferred that concept of directions, position in space, and code blocks such as "move forward, turn right, and turn left" were developed by supporting them.

4. Discussion and Conclusion

In this study, the robot drawings and interviews of children continuing preschool education were examined. The collection of two different data on the same subject provided the researchers with the opportunity to obtain deeper information on the subject. It was concluded that children's last robot drawings had more mechanical features than their first drawings. There was a certain increase in the battery, wheel, button, and antenna in children's drawings. It was concluded that children used mostly angry, confused, and unhappy expressions in their robot drawings. When children's final drawings were examined, it was determined that there was an increase in the number of robots with mechanical reflection. As a result of the interviews held, it was concluded that the children internalized the concept of scientist and learned that robots were developed by scientists and engineers. In the first interviews, many children stated that they had never seen a robot while, in the last interviews, all children stated that they saw an educational robot. It is considered by the researchers that this early experience will increase the interests and motivations of the children in the education process. As a result of the interview, it was determined that the children enjoyed the process and internalized the concepts regarding position in space.

When examined in terms of developmental psychology, it is concluded that there are reasonable justifications for the use of educational robots in kindergartens. Piaget, one of the important names in the field of child development, emphasizes the necessity of presenting objects with different characteristics to children in early childhood. The process of using objects should continue without overstraining children, and learning should be planned step by step. (Piaget, 1962). Studies on the subject emphasize that even the process of turning the computer on and off will be a step (Alexander & Rackley, 2005).

For this reason, the main purpose of the study is to enable children living in disadvantaged areas to interact with educational robots. The second main reason is to examine children's perceptions of educational robots through pictures and interviews. When the obtained data are examined, it is concluded that all the children attribute human characteristics to the robots in both the first and the last robot drawings. They drew body parts such as eyes, hands, feet, and arms. In addition, they included the emotional states of the robots in their drawings. They include feelings like happy, unhappy, angry, and confused in their robot drawings. These results are similar to previous studies (Turkle, 2007; Sharkey & Sharkey, 2010). According to related research, it is emphasized that the reason why children attribute human characteristics to robots is the design of educational robots. In addition to this, it is shared that it would be appropriate to use transparent robot designs with visible mechanical structure as a suggestion (Boden, Bryson, Caldwell et all., 2017). However, another study has concluded that even after children learn that robots are programmable objects, they continue to think that robots have emotions and free will. In short, it is emphasized that there is no change in children's thoughts about educational robot's feelings (Bumby & Dautenhahn, 1999).

5. Suggestions

Considering the results obtained from this study, the following recommendations can be made for practitioners, researchers, and policymakers: In the preschool period, longer-term training can be provided with educational robots, and activities can be organized. These activities will motivate children to discover and learn by offering a variety of materials and rich stimuli in education. Educational robots can be used from time to time in preschool educational activities to provide children with 21st-century skills. Providing coding education for children in the preschool period will support the training of young generations that not only consume technology but produce it. This study can be extended by applying it to preschool children in other public and private kindergartens for a longer period of time. Preschool teachers can carry out educational activities with robots for children and improve their coding skills through entertaining activities such as drama, play, movement, art, etc. Each child has a unique learning style and using different methods will ensure that learning becomes permanent. Instead of robot and coding tools with expensive technologies, multi-disciplinary education programs can be designed for preschool children with multifunctional materials with less cost. With these programs, children can develop creative thinking skills and their imagination, problem-solving skills, and the ability to solve a problem through different solutions. The extension of preschool coding education, which is included within the scope of compulsory education in some countries abroad, in Turkey, and carrying out intercultural studies on this subject can be encouraged.

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Appendix 1

CODING KEY FOR DRAWINGS OF CHILDREN

Physical Features in Drawings	Available	Unavailable
Body		
Arms		
Legs		
Head		
Neck		
Tall		
Short		
Big		
Medium		
Small		
Hair		
Eyes		
Mouth		
Eye brow		
Nose		
Ear		
Hand		
Foot		

Accessory	Available	Unavailable
Equipment		
Glove		
Hat		
Glasses		
Hook		

The Way Robots Work	Yes	No
Individual		
Group		

Colors	Available	Unavailable.
Red		
Yellow		
Blue		
Green		
Purple		
Orange		
Black-white		
Colored		
Metallic reflection		
Other		

Type of Lines Used in Drawings	Available	Unavailable.
Oval line		
Dashed line		
Thin continuous line		
Thick continuous line		
Zigzag line		
Other		

Other materials used when drawing robot body	Available	Unavailable
Logo		
Battery		
Cable		

Emotional State	Available	Unavailable
Happy		
Unhappy		
Angry		
Other		

Shapes	Available	Unavailable
Square		
Rectangular		
Circle		
Triangle		
Other		