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"Engineer" Perception in Early Childhood

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ABSTRACT
This study aimed to determine the "engineer" perception of 48- 72 month-old children in pre-school education. Phenomenological design, one of the qualitative research methods, was used in the study. The study group of the research consist of 52 children between the ages of 48 and 72 months attending pre-school at one private and one official kindergarten in Niğde province, Turkiye. The semi-structured interview form for determining children's perception of engineer, based on children's drawings of engineers at work, which was developed by the researcher, was used. Content analysis has been used in the analysis of data. The result suggested that the majority of the children have an insufficient perception of engineers and their work. Most of the children who want to be an engineer when they grow up do not know why they want to be an engineer, and the reasons for others vary according to their knowledge about engineering. On the other hand, children who want to be engineers when they grow up mostly want to do construction work such as house/ building. The children were most curious about the work engineers do. Most children professions that they encounter in daily life such as police, teacher and doctor. Most children who exhibited a perception of an engineer perceived an engineer as a civil engineer and as a male.

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Introduction

Although engineering is thought as one of today's popular professions, it is actually as old as human history. It is more than a profession, it is a design process. Mankind has made various designs with the materials obtained from the environment and nature since the day it existed. In this way, he was able to survive, make his life easier and find solutions to his problems. In fact, as Koen (2003) states, "to be a human is to be an engineer". One of the reasons why engineering has become important in educational studies in recent years is that engineering is included in STEM fields. Although it is the least emphasised field among STEM fields, engineering is said by Jolly (2017) to be the strongest component that holds other fields together. For this reason, research focus on engineering education has increased. While research generally focuses on middle school and high school pupils (Balçın & Ergün, 2019; Çakmak, et al., 2019; Çil & Özlen, 2019; Ergün, 2018; Fralick, et al., 2009; Gülhan & Şahin, 2018; Hammack, et al., 2015; Hyeonyeong, et al., 2012; Koyunlu Ünlü & Dökme, 2017; Madara & Namango, 2016; Montfort, et al., 2013; Nacaroğlu & Arslan, 2020), but there are also studies conducted at preschool and primary school levels (Bagiati & Evangelou, 2016; Balçın & Topaloğlu, 2019; Chou & Chen, 2017; Günşen, et al., 2019; Malone et al., 2018; McLean, et al., 2020; Pantoya, et al., 2015). Although relevant research has often focused on older children, research shows

that early childhood science and engineering education offers opportunities to engage children in hands- on learning experiences that will raise their natural curiosity about the world and develop skills such as critical thinking, problem solving, collaboration and perseverance (Bustamante et al., 2018). However, it has been determined that negative early experiences with engineering and design can lead to misperceptions about what engineering is and who engineers are, which can be extremely difficult to correct (Knight & Cunningham, 2004). Education begins in childhood and children transfer the knowledge and experiences they have acquired at an early age to later education levels (Karademir & Yıldırım, 2021) and so it is important to investigate and correctly structure the perception of engineers in the minds of children in the early period.

Engineering and STEM

Although engineering has existed since the first periods of humanity, it has started to come to the forefront and gain importance especially since the middle of the 20th century in parallel with the rapid developments in science and technology. The United States of America, aiming to take the lead in this race in science and technology, has introduced the STEM (Science, Technology, Engineering, Mathematics) approach by making radical changes in its education programs and integrating the fields of science and mathematics with engineering and technology (Bybee, 2010). Among the STEM fields, engineering is the strongest component that holds the other three fields together because, while designing products to solve a problem, learners use engineering processes to apply the knowledge and concepts which they have acquired in the fields of science and mathematics (Jolly, 2017). The engineering discipline in STEM defines what engineers do during the design process, how engineering affects society and society affects engineering (Moore, et al., 2016).

Engineering learning requires identifying opportunities to think about something new, understanding how things work, doing research and applying knowledge to create something new and appropriate for a given problem situation (Brophy, et al., 2008). Learning the use of the engineering design process can help learners strengthen their science and maths concepts, and students can learn about science, technology and engineering through active collaboration, problem solving and applications in this process (Worker & Mahacek, 2013). Engineers design technology using understandings in the fields of science and mathematics, and in this process, engineering provides a meaningful situational context that will keep science and mathematics together (Pantoya et al., 2015). Nevertheless, when compared to other fields of STEM, the studies on the field of engineering are few.

When the related studies are examined, it has been seen that the school pupils' engineering perceptions are generally focused on in the secondary school period and after it. In their study, Fralick et al., (2009) compared secondary school pupils' perceptions of scientist and engineers; they concluded that the majority of students do not have a perception of engineers, and those who have are people working outside as manual workers. Koyunlu Ünlü and Dökme (2017) have stated that the opinions of gifted students about engineering from STEM fields are generally include the perception of engineering as a male occupation. The design process dimension is also mentioned, mostly in the context of civil engineering. Ergün (2018) and Çakmak et al., (2019) also ascertained that secondary school pupils think of engineers as male, working in road construction, construction workers, drudgers or repairmen. Similarly, Nacaroğlu and Arslan (2020) examined the engineering perceptions of gifted students aged between 6 and 20 and concluded that they mostly reflected common social perceptions such as being a civil engineering, computer engineering and being a male occupation. A study conducted with 5th grade pupils, it has been determined that the pupils similarly have stereotypical perceptions such as civil engineer and male, intelligent and rich (Çil & Özlen, 2019). Gülhan and Şahin (2018) stated that 5th and 7th grade students have a similar perception of engineers, however, as the class level of girls increases, the perception of engineers as females decreases. Balçın and Ergün (2019) examined the 6th grade pupils' perceptions of aviation and aerospace engineering and concluded that the students have misconceptions in this area and have stereotypical gender

perceptions towards engineering. When Hyeonyeong, Sookyeong and Youngmin (2012) examined middle school students' engineering perceptions, students generally perceived them as male and working in outdoor environments, and that while boys made reference to design, invention and product creation, girls mostly have perceptions about car mechanic. Madara and Namango (2016) investigated the engineering perceptions of high school girls in Kenya. Most of them appeared to have a good idea and positive attitude about what engineering is, but the rest perceived it as dirty and noisy handicraft. Chou and Chen (2017) investigated the engineering perceptions of primary school children in Taiwan. They exhibited stereotypical gender perceptions of engineers. Family members and mass media strongly influenced their conceptions of engineering.

Young children actually have innate engineering skills and actually use engineering processes while making sandcastles and building houses (Jorgenson, Vanosdall, Massey & Cleveland, 2014). The National Academy of Engineering designed STEM activities for young children emphasising the challenging and exciting aspects of engineering, and found that when the lessons are supported by examples based on life and careers, they attract attention and children's interest increases (National Academies Press (NAP), 2008 cited by Gomez and Albreth, 2014). Recent studies report that the developmental characteristics of young children are amenable to understanding engineering concepts and applications (Çil, 2018). Unfortunately, when compared with other fields of STEM, there are relatively few studies on the engineering concept in early childhood, its education and learning. In their study with 5-year-olds, Günşen et al. (2019) examined the perceptions of children about STEM fields and stated that none of them expressed an opinion about engineering field. Malone et al. (2018) investigated the effect on 4 to 8-year-olds understanding of conceptual technology and engineering by integrating technology, engineering and mathematics courses into inquiry, visual arts and physical education courses. They determined that the integration provided significant improvement in their understanding of engineering and increased their understanding of what engineers do by an average of 55%. They maintain that engineering education should start from an early age. Likewise, Pantoya et al., (2015) developed a curriculum around an engineering storybook to introduce children between the ages of 3 and 7 to engineering and to develop engineer identity. Academic discussions and creative drawing activities were also held around these stories. Children developed a positive engineer identity by enabling them to work like engineers.

Although it is an important component among STEM fields, early exposure to engineering, which is the least emphasised field, offers important opportunities for children (Bustamante, et al., 2018). Determining the "engineer" perception of children at a young age is considered important in terms of preventing misconceptions and prejudices that will occur in the future. With the inclusion of engineering design processes in the curriculum from pre-school and the correct acquisition of the concepts of "engineer" and "engineering", it can be ensured that children begin to gain the skills of problem solving, critical thinking and cooperation from an early age. The fact that no study has been found in the literature to determine the engineers' perceptions of preschool children is considered important in terms of the contribution of the results obtained from the study to the literature. In this context, it is expected that the research findings will shed light on early STEM practices in terms of making children realise and comprehend the concept of engineering, what engineers do and how they work in the process. Therefore, in this study, it was aimed to determine the "engineer" perception of 48- 72 months old children. In accordance with this purpose, the following Research Questions were posed:

- What are the children's views on which profession they will choose in the future?
- What are the children's views on who the engineer is?
- What are the children's views about the engineer's work?
- Why do children become an engineer?
- What do they want to produce when they become an engineer?
- What are the situations that children wonder about engineers?

Methods

Research Design

Phenomenological design, one of the qualitative research methods, was used in the research. Phenomenology is used to examine and explain events, concepts, experiences and situations (Sönmez& Alacapınar, 2014). The design constitutes a suitable research ground for investigating the phenomena that are not completely foreign to us but whose meaning we cannot grasp (Yıldırım & Şimşek, 2013). Through this design, the relationships between the individual and what he/she is trying to understand or learn are investigated with a view to improving individual learning (Çepni, 2021). In this context, the perception of engineering by young children was considered as a phenomenon, which could be elucidated through interviews.

Study Group

The study group consisted of 52 children aged between 48- 72 months who were in pre-school education in two kindergartens, one private and one public, in Niğde, Turkiye. Convenience sampling, one of the purposive sampling methods, was used to determine the study group. Since the researcher chooses a situation that is close and easy to access in this method, it adds speed and practicality to research (Yıldırım & Şimşek, 2013). Demographic information of the children participating in the study is given in Table 1.

Table 1

Demographic Information of the Children Participating in the Study

Age	Female	Male	Sum
48- 60 months	8	8	16
61- 72 months	19	17	36
Sum	27	25	52

Data Collection Tools

Semi- Structured Interview Form for Determining Children's Perception of Engineers developed by the researcher and drawings of an engineer and her/his work were used to obtain the data.

Semi- Structured Interview Form for Determining the Engineer Perception of Children

In the process of preparing the form which was developed by researcher, a literature review was conducted (Günşen et al., 2019; Knight & Cunningham, 2004; Pantoya et al., 2015) and accordingly a draft form was prepared. The questions were prepared in accordance with the developmental characteristics of the children so that they would not get bored and could easily answer them. To ensure content validity, the draft form was sent to three experts, a STEM education expert, a preschool education expert who has studied on STEM education, and a preschool teacher who has STEM training. In line with expert opinions, the question "How many types of engineers are there?" was removed and the question "What do you want to be when you grow up?" was added. The form was piloted by applying it to three children aged 52, 62 and 68 months who were at another kindergarten that did not participate in the research. As a result of the pilot scheme, it was seen that the children gave the same answers to the questions " What do engineers do in their work?" and "What do engineers do?" and the question "What do engineers do in their works?" has been removed from the form. Interview form in its final form as follows;

1- What do you want to be when you grow up? Why?
2- Who do you think is an "engineer" is?
3- What do engineers do?
4- Do you want to be an engineer? Why?
5- What would you like to produce when you grow up and become an engineer?
6- If an engineer was here, what would you like to ask him/her?
It consists of 6 questions in total.

Drawings of an Engineer and His/Her Work

The children were asked by the researcher to draw a picture of an engineer and his/her work. There was no interference during the drawing. By creating a nonverbal language, painting is an important tool that can be used to get to know children by facilitating the expression of children who have difficulties in verbal communication (Yavuzer, 2016). In this context, drawings were used to make it easier to understand the thoughts of the children who were hesitant during the interviews and could not express themselves adequately. In order to deepen the drawings, interviews were held with each student about their drawing.

Before conducting the data collection tools, both the school administration and the parents were informed about the purpose and scope of the study, and it was stated that the children could leave the study at any stage of the study if they did not want to. Written permission was obtained in this direction, and participation was based on volunteerism. Before the data were collected, it was stated to the children that they could leave the study at any time they did not want to. After the process started, 2 children left the study expressing that they were bored. The drawings were done in class while interviews were conducted with each child individually in a separate and quite environment. The interviews were tape recorded. Firstly, questions about getting to know the child were asked in order to warm up the children, and then the research questions were asked. Each interview lasted approximately 15 minutes.

Data Analysis

Content analysis, one of the qualitative data analysis methods, was used. Content analysis is carried out to reach concepts and relationships that can explain the collected data (Yıldırım & Şimşek, 2013). In the evaluation of the children's drawings, the opinion of an expert who works on image analysis in the field of child development was taken. In line with interviews with the children and the opinions received, items in the drawings were coded and the common codes were grouped under categories. The data obtained from the interviews were put on computer. By dividing the transferred data into sections, it was tried to determine what each section meant and the meaningful sections were coded. In order to ensure validity and reliability, the concepts were coded by two independent people and Miles and Huberman's (1994) consensus/disagreement formula (Reliability = Consensus/ Consensus + disagreement) was used to determine the agreement between evaluators. It was determined that two different coders coded the concepts similarly at a rate of 92%. If the consistency in the reliability calculation is over 70%, the research is considered reliable (Miles & Huberman, 1994). After the coding process, the codes created were brought together and their common aspects were determined, and this way, the categories of research findings were revealed. Since more than one code could be created from the answer given by a student, the frequency sum was found to be larger than the study group. Sample quotations were included in order to reveal the children's perspectives more clearly.

Findings

The data of this study, which aims to determine the engineer perceptions of 48- 72 months old children, were obtained from the interviews with the children and the drawings of the children about an engineer and his/her work. The children were coded as C_1, C_2, C_3, ..., C_{52}. The findings obtained from the analysis of the data have been given in tables.

Table 2

The Findings from Drawings of an Engineer and His/Her Work

Categories	Codes
Gender (52)	Female (6), Male (17), Nonresponse (29)
Material (67)	House (9), Building (3), Pencil (3), Hammer (3), Kitbag(3), Test Tube (3), Notebook/Paper (2), Car (2), Chain (1), Drill (1), Locker (1), Woods (1), Iron cutting machine (1), Nail box (1), Paint box (1), Brush (1), Log (1), Shelf (1), Ladder (1), Park (1), Project table (1), Road (1), Train (1), Flower (1), Crane (1), Concrete mould (1), Puppet (1), Articulated lorry (1), Brick (1), Nonresponse (18)
Clothes (52)	Casual dress (7), Helmet (6), Pants (5), Dress (4), Shirt (3), T-shirt (2), Goggles (2), Personal protective equipment (2), Stethoscope (1), Nonresponse (20)

When Table 2 is examined, it is seen that there are three categories of children's drawings; the engineer's gender, the materials they use, and their clothes. While some of children did not specify gender in their drawings (n= 29), those who indicated gender generally drew an engineer as a male (n= 17). Nonetheless, it is seen that there are children (n= 6) who drew female engineers. The children generally associated engineers with structures such as houses (n=9) and buildings (n= 3) in their drawings. However it is seen that they also make construction-related associations such as pencil (n=3), hammer (n=3), tool bag (n=3), crane (n=1), project table (n=1). Some children thought of engineers as scientists and associated them with test tubes (n=3), while others thought of them as landscape architects and made associations such as parks (n=1) and flowers (n=1). Eighteen of the children did not make any associations in this category. When the drawings are examined in the clothing category, it is seen that the children similarly make a connection with the construction industry and draw a helmet (n=6). Besides all these, there are also children with drawings such as goggles (n=2) and personal protective equipment (n=2). While 20 children did not specify any clothes, one child drew a stethoscope due to incorrect or incomplete information. Examples of children's drawings are given below.

Figure 1

Drawing of C_9 (48- 60 months)

Figure 2

Drawing of C_{11} (60- 72 month)

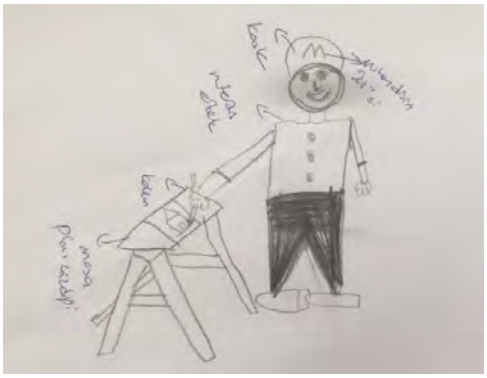


Figure 3

Drawing of C_{12} (60- 72 months)

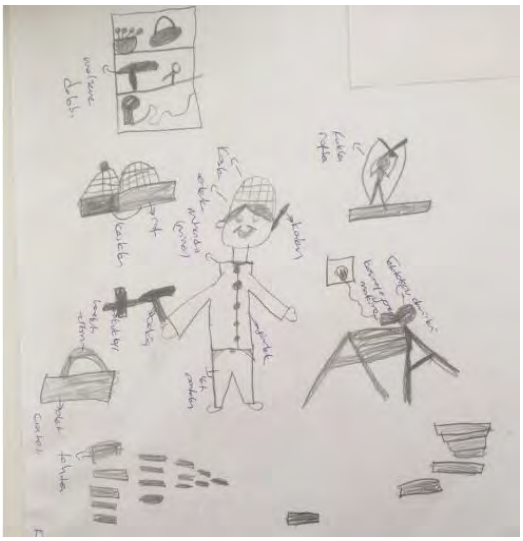
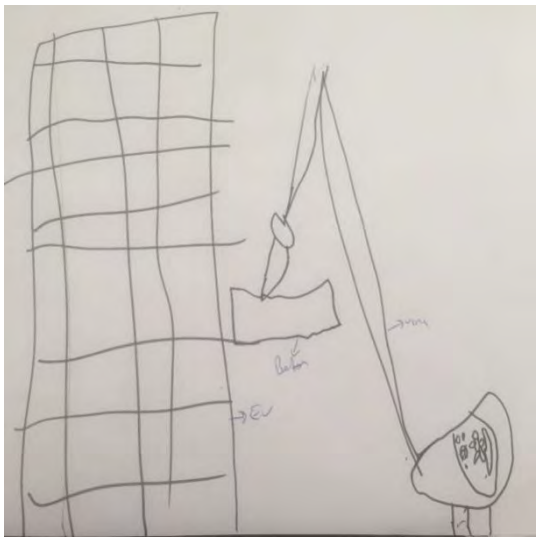


Figure 4

Drawing of C_{49} (60- 72 months)



The findings regarding the occupations that children want to be in the future are given in Table 3.

Table 3

The Findings Regarding the Professions that 48- 72 Months Old Children Want to Be in the Future

Profession	F	%
Police	15	26,79
Teacher	8	14,28
Doctor	8	14,28
Constructer	3	5,35
Engineer	3	5,35
Mechanic	2	3,57
Ballerina	2	3,57
Soldier	2	3,57
Fireman	2	3,57
Sportsman	2	3,57
Dentist	1	1,79
Airplane pilot	1	1,79
Racing driver	1	1,79
Architect	1	1,79
Nurse	1	1,79
The person running a cafe	1	1,79
Pharmacist	1	1,79
Nonresponse	2	3,57
Total	56	100

According to Table 3, children mostly want to have occupations they regularly encounter around them, such as police (26,.9 %), teacher (14,28 %) and doctor (14,28 %) with occupations such as pilot (1,79 %), architect (1,79 %), pharmacist (1,79 %) being opted for by one child only. Only 3 children (5,35 %) stated that they wanted to be an engineer. 2 children (3,57 %) did not give an answer.

It can be said that parents' occupations and environmental interaction are generally effective in children's profession choices. Some of the children's answers are given below:

C_2: I would like to be an engineer. Because they make a lot of money.

C_{18}: I would like to be a police. Because, like my father, I want to catch criminals.

C_{33}: I want to be a doctor. Because I want to cure people.

The findings regarding the answers given by the children about who is an engineer are given in Table 4.

Table 4

The Findings of 48- 72 Months Old Children's Answers to the Question "Who is an Engineer?"

Categories	Codes
Regarding construction (12)	Constructor (6), the person building a house (2), the person drawing a construction plan (1), there is something yellow on their caps (1), the person drawing houses (1), makes the buildings drawn by architects (1)
Regarding repair/ breakdown (3)	The person repairing a natural gas failure (1), the person repairing something (1), the person helping the broken thing (1)
Hardworking person (3)	A very hardworking person (2), The person working on a computer (1)
Family members (3)	My father (3)
Scientist (2)	Scientist (1), The person creating something(1)
Regarding gender (1)	Woman (1)
Misinformation (14)	Police engineer (2), school principal (2), Police (2), Painter (1), Captain (1), the person working at hospital (1), the person helping animals (1), ambulance driver (1), the person making an exam (1), basketball player (1), the richest man on the plane (1)
No answer (12)	I do not know (12)

When Table 4 is examined, it is seen that the majority of the children did not respond (n= 12), or displayed incorrect conceptions (n= 14) through answers such as the school principal (n=2), the police (n=2), basketball player (n=1). Besides, it is seen that the children who have an idea about the engineers generally think of engineers as construction-oriented (n=12) such as constructors (n=6), or the person building a house (n=2). On the other hand, it is seen that some children think about repairing/ breakdown (n=3), such as the person repairing the natural gas breakdown (n= 1), the person helping the broken thing (n=1). Three children perceived engineers as hardworking people and two scientists in terms of their personalities. However, it is seen that children who know it as their parents' job expressed as "my father" (n=3). One student defined it as a woman (n=1) due to his mother, who is an engineer. It can be said that parental professions and environmental interaction play an important role in children's perceptions of whom the engineers are. Below are some of the children's answers:

C_9: The person building a house

C_{30}: Engineers make the structers drawn by architects.

C_{35}: He makes construction, repairs natural gas failure.

The findings regarding the answers given by the children to what an engineer does are given in Table 5.

Table 5

The Findings of 48- 72 Months Old Children's Answers to the Question "What Do Engineers Do?"

Categories	Codes
Construction (22)	To build a house (9), to build a building (5),to build a car-park (1), to making concrete (1), to build a bridge (1), to build a school (1), to making different tools with wood (1), to blaze a trail (1), to build a cottage (1), to make a work (1)
Drawing (8)	To draw a building (1), to draw a house (1), to draw a park (1), to draw a swing (1), to draw a market (1), to write (1), to make a drawing (1), to draw a picture (1)
Repair (5)	To repair (4), to weld (1)
Experiment/ Potion (5)	To do an experiment (2), to make a potion (2), to make something into another thing (1)
Working/ earning money (3)	To work in the office (1), to work (1), to earn money (1)
Electricity (1)	To engage with electricity (1)
Robot (1)	To make a robot (1)
Misinformation (20)	To catch a thief (1), to police (1), to sell a television (1), to sell a computer (1), to shoot with his/her camera (1), to imprison criminals (1), to architect (1), to carry stones (1), to plant a tree (1), to tell teachers questions to ask (1), to try to find something like bone (1), to extinguish the fire (1), to drive an ambulance (2), to make an exam (1), to juggle a soccer ball (1), to help people (1), to read a book (1), to glass blower (1), to help the elderly (1)
No answer (9)	I do not know (9)

According to Table 5, most children gave answers relating to the construction industry (n=22) such as building houses (n=9), building a building (n=5), building a bridge (n=1), building roads (n=1). However, there are also children who alluded to technical drawing (n=8), One child stated that engineers engage with electricity and another mentioned building robots. Twenty children think that engineers do work related to different occupations, and 9 children did not know. Here are some examples of the children's answers:

C_1: They build a building, build houses, build whatever they want.

C_{15}: They repair, build houses, build roads.

C_{49}: They build a building, draw pictures.

The findings regarding the answers given by the children to the question "Why do you want to be an engineer?" are given in Table 6.

Table 6

The Findings Regarding the Answers Given by 48- 72 Months Old Children to the Question "Why Do You Want to Be an Engineer?"

Categories	Codes
Construction (8)	To build a house (3), to make a car (1), to build everything (1), to make a wall (1), to compose (1) , to build a building (1)
Electricity (1)	To engage in electricity (1)
Curiosity (1)	Out of curiosity (1)
Experiment (1)	To do an experiment (1)
Answer based on wrong/incomplete information (5)	To be rich (1), to do people a favour (1), to fly (1), to help animals (1), to tell children about an exam (1)
Irresolute (26)	I do not know (26)
Adverse (10)	I do not want to be an engineer (10)

When table 6 is examined, it is seen that the reasons of children for choosing to be engineers vary according to their knowledge about engineering. While 8 of children stated that they wanted to be an engineer to work in construction, there were also children who stated that they wanted to be an engineer to engage in electricity, to do an experiment and just out of curiosity. Children who have wrong or incomplete knowledge about engineering gave answers such as flying (n=1) and helping animals (n=1). While 26 children stated that they wanted to be an engineer but did not know why they wanted to be an engineer, 10 children stated that they did not want to be an engineer. Below are some examples of the children's answers:

C_2: I would like to be a civil engineer, I will build a house.

C_9: I like engineers and I want to deal with electricity.

C_{38}: Because I wonder very much.

The findings regarding the answers of children about what they want to produce if they become engineers when they grow up are given in Table 7.

Table 7

The Findings About What 48-72 Months Old Children Want to Produce If They Become Engineers When They Grow up

Categories	Codes
Building/House (7)	Apartment building (4), brown-black- white house (1), building (1), concrete (1)
Furnish (3)	Bookcase (2), table (1)
Electronics/ Robotics (3)	Battery-powered car (2), robot (1)
Drawing (3)	Drawing a picture (2), drawing a city (1)
Natural gas (1)	Deal with natural gas (1)
Irrelevant answer (4)	Limitless money (1), money machine (1), researching their bones when people die (1), whatever comes to my mind (1)

According to Table 7, when it is examined what children want to produce if they become engineers, they mostly want to construct a building (n=7), and also to produce electronics/ robotics products (n=3) and to do works related to natural gas (n=1). However, it is also seen that there are answers based on incorrect or incomplete information such as limitless money (n=1) and money

machine (n=1). Thirty-one of the children did not want to answer this question. Some of the children's answers are listed below:

C_9: I would like to build an apartment building.

C_{10}: I would like to concrete the buildings.

C_{20}: I would like to draw the whole city.

The findings regarding the answers given by the children to the question "If an engineer were here, what would you like to ask him/her?" are given in Table 8.

Table 8

The Findings Regarding the Answers Given by 48- 72 Months Old Children to the Question "If an Engineer Were Here, What Would You Like to Ask Him/Her?"

Categories	*Codes*
About their work (29)	What do you do? (10), How do you fix it? (3), how do you build a house? (6), How do you build a model house? (1), how do you raise a building? (4), how to make a car? (1), how to build a school? (1), How do you make concrete? (1), how do you draw? (1), how to make a potion? (1),
About electricity (4)	How to use electricity? (2), What is there inside electricity? (1), what does electricity do? (1)
About their clothes (2)	How do you get dressed? (1), how do you wear those glasses? (1)
About where they live (1)	Where do you live? (1)
Irrelevant answer (4)	Can we do business with you? (1)I ask something about mathematics (1), How do you heal animals? (1), How much is 2x2? (1)
No answer (12)	I do not know (12)

According to Table 8, it has been seen that the children mostly wanted to ask the engineers about the work they did (n=29), respectively followed by the questions about electricity (n=4), the clothes they wore (n=2) and the place they lived (n=1). Apart from this, it was determined that 4 children wanted to ask irrelevant questions and 12 children did not know what to ask. Below are examples of children's answers:

C_5: How to make a car or build a school? I will ask this, I wonder it.

C_{18}: Where do you work? I would like to ask.

C_{47}: How do you wear those glasses? Do not they hurt your ears? I ask.

Discussion and Conclusion

Although it has been claimed to be the most important component that holds STEM fields together, engineering is the least emphasised among these fields. Gaining the perceptions of engineering in the early period provides important opportunities for children (Bustamante et al., 2018). This study was carried out to determine the engineering perception of 48-72 months old children. The results obtained from the children's drawings show that the children generally perceive an engineer as a male. It was understood during the interviews that those who did not state gender in their drawings generally perceive an engineer as a male. However, there are few children who think that engineers are woman. When the literature is examined, no such result has been found for preschool children, and it is seen that in studies conducted at primary and secondary school level, students mostly perceive engineers as male (Chou & Chen, 2017; Çil & Özlen, 2019; Hyeonyeong vd.,

2012; Koyunlu Ünlü & Dökme, 2017; Nacaroğlu & Arslan, 2020). Furthermore, Gülhan and Şahin (2018) noted that as the grade level increases, girls' perceptions of female engineers decrease. This result likewise shows that the children have stereotypical gender perceptions towards engineering from a young age. Dismantling this perception in the early period can enable girls to overcome some of the obstacles in their way in relation to entering engineering fields in the future.

According to the results of the children's answers given to the question "Who is an engineer?", most children had no idea while most responded perceived an engineer as a person who does construction work or as a person who does repair work. When the drawings of the children are examined, it is seen that they associate an engineer with materials related to construction and repair such as house, building, pencil, hammer, toolbox, drill. In their studies with secondary school students, Koyunlu Ünlü and Dökme (2017) and Ergün (2018) stated that most of the students perceive engineers as civil engineers. Unsurprisingly, there were children who responded according to the jobs of their family members, particularly their parents. Chou and Chen (2017) stated that family members strongly influence children's perception of engineers. These results suggest that the models that a child observes more in his/her close environment and daily life are effective in his/her engineer perception. While children mostly drew an engineer without any special clothing, some children also drew engineers as people wearing safety glasses and protective clothing, helmets/ hardhats. Likewise, in the study conducted with secondary school pupils by Çil and Özlen (2019), it was stated that there are perceptions of clothing used in the construction field such as protective glasses, protective clothing, and hardhats. It can be surmised that this situation stems from the perception of engineering as mostly civil engineering.

It was concluded that most of the children had wrong or incomplete information about the work of engineers or could not answer at all. In their study, Fralick et al. (2009) also stated that most of the secondary school pupils do not have an engineer perception. In their study with 5-year-old children, Günşen et al. (2019) stated that almost none of them had any idea about engineering, which is one of the STEM fields in the minds of children. Similar to this result, in their study with more than 300 children aged 3-7 years, Pantoya et al. (2015) stated that most of the children did not know what an engineer was doing, and most of the others thought that engineers used trains. These results are consistent with the results of this research. However, it has been concluded that there are also children who have a perception of construction such as construction, drawing and repair, and some of them perceive engineers as scientists and thus conducting experiments. Some children stated that engineers made potion. Gülhan and Şahin (2018) stated that 5th and 7th grade students fall into this misconception in their perception of a scientist. These results suggest that misperceptions that are formed in the early period or are not corrected continue in the following years. When the first perceptions are structured correctly in children's minds, they can prepare the ground for the future and enable them to develop a positive perspective on engineering.

When children are asked why they want to be an engineer when they grow up, it is seen that most of them cannot give reasons and some of them do not want to be an engineer. It is seen that those who want to be an engineer and give reasons, do so based on the perception of civil engineers, such as building a house, constructing a building, or building walls. Additionally, it is seen that there are some children who want to be an engineer to engage in electricity or because of curiosity. Some children, on the other hand, gave non-engineering answers because of their incorrect or incomplete information. It is obvious that young children do not have much knowledge about engineers and their jobs.

In parallel with this question, when asked about what they would like to produce if they became an engineer, it was seen that the majority of them gave answers about construction such as building/house, however, they gave answers about electronics, robots, natural gas or the drawing part of engineering. These results again suggest that the image of an engineer that children encounter in their immediate environment is very effective in their perceptions.

In the questions that children want to ask an engineer, it is seen that they mostly want to ask questions about their work. Similarly, there are also some children who want to ask questions about electricity.

These results suggest that children particularly do not have enough knowledge about what engineers do.

Regarding the occupations that children want to enter in the future, it is seen that they prefer those that they encounter more in their daily lives such as police, teachers, and doctors. Günşen et al. (2019) obtained similar results in their study with 5-years-old children. Three children stated that they want to be an engineer because of parental models in at least one case. This result also makes us think that the close environment and the individuals around who can be taken as a model are effective in the choice of profession. Considering that most of the current popular professions will disappear in the near future, it has been thought that it is important to make children aware of different professions from a young age.

As a result, it is generally seen that children do not have a sufficient level of awareness of engineering perception or they have stereotypical perceptions. The family, the immediate environment and the media all have an effect on children's concepts about engineers. In the studies conducted, it is also stated that family members and mass media are important for children to have engineering experience at an early age and to determine their attitudes towards engineering in the future (Chou & Chen, 2017).

Based on these results, the following recommendations can be made:

There is evidence concerning that STEM education from an early age is more effective (Becker & Park, 2011). While applying STEM education in the preschool period, it can be ensured that the engineering component is emphasised and put forward. In this process, different engineering branches can be included in addition to civil engineering. Including pre-school STEM education can increase interest in professions in these disciplines (Gonzalez& Freyer, 2014).

Given that the immediate environment has an effect on the perceptions of children, engineers from different branches can be invited to schools in order to get to know engineers better, and the opportunity to interact with children can be provided. Especially in order to change the perception that an engineer is a male profession, more female engineers can be preferred.

In the study of Karademir and Yıldırım (2021), it was determined that pre-school teacher candidates also have stereotypes and misconceptions about the engineering identity. It is important that teachers who will train pre-school students have correct perceptions about engineers. Therefore, preschool teachers can be given hands-on STEM education through various courses, the engineering process can be taught and they can be provided with STEM activities by which they can handle different engineering fields in their classrooms. In the context of engineering design, STEM learning can be done using hands on activities and technology (Brophy et al. 2008). Thus, children can be helped both to realise the engineering design process and to develop correct perceptions about engineers and their work.

It is a suitable period for children aged three to six to understand engineering concepts and activities (Çil, 2018). In this period, the effects of engineering design- oriented activities on children's perception of engineers can be investigated.

References

Bagiati, A. & Evangelou, D. (2016). Practicing engineering while building with blocks: identifying engineering thinking. *European Early Childhood Education Research Journal, 24*(1), 67- 85.

Balçın, M. D. & Ergün, A. (2019). Altıncı sınıf öğrencilerinin gözünden havacılık ve uzay mühendisi. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 45*, 1- 21.

Balçın, M. D. & Topaloğlu, M. (2019). Okul dışı öğrenme ortamlarında ilkokul öğrencilerinin mühendislere ve bilim insanlarına yönelik algılarının incelenmesi. *Ordu Üniversitesi Sosyal Bilimler Araştırmaları Dergisi, 9*(1), 157- 170.

Becker, K. & Park, K. (2011). Effects of integrative approaches among science, technology, engineering and mathematics (STEM) subjects on students' learning: A preliminary- meta analysis. *Journal of STEM Education, 5*(6), 23- 37.

Brophy, S., Klein, S., Portsmore, M. & Rogers, C. (2008). Advancing engineering education in P-12 classrooms. *Journal of Engineering Education,* July, 369- 387.

Bustamante, A. S., Greenfield, D. B. & Nayfeld, I. (2018). Early childhood science and engineering: engaging platforms for fostering domain- general learning skills. *Education Sciences, 8*(144), 1-13.

Bybee, R.W. (2010). What is STEM education. *Science, 329*, 996. Doi: 10.1126/science.1194998

Chou, P. & Chen, W. (2017). Elementary school students' conceptions of engineers: A drawing analysis study in Taiwan. *International Journal of Engineering Education, 33* (1), 476- 488.

Çakmak, B., Bilen, K. & Taner, M. (2019). Ortaokul öğrencilerinin mühendis ve mühendislik algıları. *Anadolu Öğretmen Dergisi, 3(*1), 32- 43.

Çepni, S. (2021). *Araştırma ve proje çalışmalarına giriş (ninth edition).* Celepler.

Çil, E. (2018). Okul öncesi dönemde STEM eğitimi. In Salih Çepni (Ed.), *Kuramdan Uygulamaya STEM +E+A Eğitimi* (pp. 457-483). Pegem.

Çil, E. & Özlen, S. (2019). Beşinci sınıf öğrencilerinin mühendis ve mühendislik algılarının incelenmesi. *Bolu Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 19*(4), 1272- 1287.

Ergün, A. (2018). Türk ortaokul öğrencilerinin mühendislik ve teknoloji algıları: Sınıf düzeyi ve cinsiyetin etkisi. *International Journal of Human Sciences, 15*(4), 2657- 2673.

Fralick, B., Kearn, J. & Thompson, S. (2009). How middle schollers draw engineers and scientists. *J Sci Educ Technol 18*, 60- 73.

Gomez, A., & Albrecht, B. (2014). True STEM education. *Technology and Engineering Teacher, 73*(4), 8-17.

Gonzalez, M. & Freyer, C. (2014). A collaborative initiative: STEM and universally designed curriculum for at- risk preschoolers. *National Teacher Education Journal, 7*(3), 21-29.

Gülhan, F. & Şahin, F. (2018). Ortaokul 5. ve 7. Sınıf öğrencilerinin mühendisler ve bilim insanlarına yönelik algılarının karşılaştırmalı olarak incelenmesi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi (EFMED), 12*(1), 309- 338.

Günşen, G., Uyanık, G. & Akman, B. (2019). 5 yaş çocuklarının zihinlerindeki bilim insanı imajı içerisinde STEM alanlarının yer alma durumlarının incelenmesi. *Mehmet Akif Ersoy Eğitim Fakültesi Dersigi, 52*, 320- 339.

Hammack, R., Ivey, T.A. & Utley, J. (2015). Effect of an engineering camp on students' perceptions of engineering and technology. *Journal of Pre- College Engineering Education Research (J- PEER), 5*(2), 1-12.

Hyeonyeong, K., Sookyeong, P. & Youngmin, K. (2012). A comparative study of middle school students' images and perceptions of scientist, technician and engineer. *J Korea Assoc. Sci. Edu. 32*(1), 64- 81.

Jolly, A. (2017). *STEM by design. Strategies and activities for grade 4-8.* Routladge.

Jorgenson, O., Vanosdall, R., Massey, V., & Cleveland, J. (2014). *Doing good science in middle school: a practical STEM guide.* (Expanded 2nd Edition). National Science Teachers Association.

Karademir, A. & Yıldırım, B. (2021). A different perspective on pre-school STEM education: STEM education and views on engineering. *Journal of Turkish Science Education, 18*(3), 338- 350.

Knight, M. & Cunningham, C.M. (2004, June). *Draw an engineer test (DAET): development of a tool to investigate students' ideas about engineers and engineering*. [Conference presentation]. Proceedings of the 2004 ASEE annual conference and exposition, Salt Lake City, Utah.

Koen, B. V. (2003). *Discussion of the method, conducting the engineer's approach to problem solving.* Oxford University Press.

Koyunlu Ünlü, Z. & Dökme, İ. (2017). Özel yetenekli öğrencilerin FeTeMM'in mühendisliği hakkındaki imajları. *Trakya Üniversitesi Eğitim Fakültesi Dergisi, 7*(1), 196- 204.

Madara, D.S. & Namango, S. (2016). Perceptions of female high school students on engineering. *Journal of Education and Practice, 7*(25), 63- 82.

Malone, K. M., Tiarani, V., Irving, K. E., Kajfez, R., Lin, H., Giasi, T. & Edmiston, B. W. (2018). Engineering design challenges in early childhood education: effects on student cognition and interest. *European Journal of STEM Education, 3*(3),1-18.

McLean, M., Nation, J. M. & Spina, A. (2020). The importance of collaborative design for narrowing the gender gap in engineering: An analysis of engineering identity development in elementary students. *Journal of Pre-College Engineering Education Research, 10*(2), 17- 34.

Miles, M.B., & Huberman, A. M. (1994). *Qualitative data analysis: An expanded source book.* Sage.

Montfort, D. B., Brown, S. & Whritenour, V. (2013). Secondary students' conceptual understanding of engineering as a field. *Journal of Pre- College Engineering Education Research (J- PEER), 3*(2), 1-12.

Moore, T.J., Johnson, C.C., Peters- Burton, E.E., & Guzey, S.S. (2016). The Need for A STEM road map. In C.c., Johnson, E.e., Peters- Burton & T.J. Moore (Eds.), *STEM Road Map a Framework for ıntegrated STEM education* (pp. 3-12). New York: Routledge.

Nacaroğlu, O. & Arslan, M. (2020). Özel yetenekli öğrencilerin mühendislik algılarının çiz- yaz- anlat tekniği kullanılarak incelenmesi. *Ege Eğitim Dergisi, 2*(1), 112- 128.

Pantoya, M. L., Munoz, Z. A.& Hunt, E.M. (2015). Developing an engineering identity in early childhood. *American Journal of Engineering Education, 6*(2), 61- 68.

Sönmez, V. & Alacapınar, F. G. (2014). *Örneklendirilmiş bilimsel araştırma yöntemleri.* Anı.

Worker, S. & Mahacek, R. (2013). 4-H out-of- school STEM education. *Children's Technology and Engineering, 18*(2), 16-20.

Yavuzer, H. (2016). *Resimleriyle çocuk, resimleriyle çocuğu tanıma.* Remzi Kitabevi.

Yıldırım, A., & Şimşek, H. (2013). *Sosyal bilimlerde nitel araştırma yöntemleri*. Seçkin.