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DETERMINING 1ST–4TH GRADE ELEMENTARY SCHOOL STUDENTS' PERCEPTIONS OF SCIENTISTS

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Abstract: The main purpose of this study is to determine the perceptions of elementary school students (1,2,3 and 4) about science and scientist. The study has been included three different elementary schools in the city center of Kastamonu in northwest Turkey. A total of 1862 students in the first (n = 480), second (n = 450), third (n = 471) and fourth (n = 461) classes participated in the study. The Draw-a-Scientist Test (DAST) developed by Chambers (1983) was used to determine the views of students about scientists. The content of the collected data was analyzed. It was found that the majority of the students, in total and at all grades, drew pictures of male scientists. It was determined that they made drawings of scientists who were in daily clothes, had well-groomed hair and were working in different environments (nature, space, etc.).

Key words: science, scientist, Draw-a-Scientist Test (DAST), elementary education

1. Introduction

Together with the reform movements in the field of education, the concept of "scientific literacy" is frequently mentioned. It is possible to see various definitions for this concept in the literature. According to DeBoer (2000), scientific literacy is what people need to know about science in order to live more effectively than the natural world. Scientific literacy is a concept that involves a range from comprehending to interpreting of the content and nature of science, scientificness and the relationship between science-technology-society as one of the most important factors triggering the personality development process within the community life. The basic characteristic of scientific literacy is expressed as 'the ability to apply scientific understanding to life situations involving science' in PISA 2006. In addition, the report describes four characteristics that a scientific literate individual should possess. These characteristics (OECD, 2006);

- •Scientific knowledge and use of that knowledge to identify questions, acquire new knowledge, explain scientific phenomena and draw evidence-based conclusions about science-related issues,
- •Awareness of how science and technology shape our material, intellectual, and cultural environments,
- •Willingness to engage in science-related issues and with the ideas of science, as a reflective citizen,
- •Understanding of the characteristic features of science as a form of human knowledge and enquiry.

When the definitions are examined, it can be said that a basic assumption for scientific literacy is the application of scientific knowledge to basic living conditions (Bybee & McCrae, 2011). It is noteworthy that in scientific literacy it is necessary not only to have scientific knowledge but also to know how to use knowledge and scientific processes for producing new information. One aspect of the definition of scientific literacy included in the report of PISA "Assessing Scientific, Reading and Mathematical Literacy" and also described above is the understanding that science is obtained as a result of human knowledge and inquiry. Raising students as scientific literate individuals is achieved

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not only by understanding the existing scientific concepts and facts, but also by understanding how the knowledge is produced, reproduced and approved, that is, how scientists work (Goodrum, Hackling, & Rennie, 2001). This indicates that the scientists who are the producer of scientific knowledge and the subject of science, and their activities should be understood correctly. In particular, determination of the perception of the primary school students with respect to scientists in the first stage of their education life increases the importance of providing them with a more accurate perception of science and scientists. Because in the literature, it is emphasized that students should be educated as a scientific literate individual (Finson, Beaver, & Cramond, 1995) and that students should be allowed to gain the right perception of scientist, if they are interested in scientific activities and they wish to plan a career accordingly (Finson, Beaver, & Cramond, 1995; Buldu, 2006; Finson, 2002). The object of our study is to determine the primary school students' (1th, 2nd, 3rd and 4th grade) perceptions of scientists by considering all these aspects.

2. Theoretical background

The first study inquiring about students' perceptions of science and scientists was conducted by Mead and Metraux (1957). For this purpose, they asked open-ended questions and concluded that students perceive scientists as men working in a laboratory, wearing glasses and a white lab coat, and who are either middle-aged or older. The students indicated that they perceive glass materials, Bunsen burner, test tubes, and weird machinery as the research tools of scientists. They argued that scientists always read books and study by taking notes in notebooks.

Mead and Metraux (1957) asked open questions to high school students and asked them to answer. While it is easier for high school students to answer open-ended questions in writing or orally, this can be more difficult at primary and pre-school level. Drawings can be seen as a way of expressing an individual's inner world and a reflection of their mental structures (Halmatov, 2016). Drawing is a stronger tool than speaking for expressing, telling, and reflecting what children are trying to communicate (Temel & Güllü, 2016). Since drawings are accepted as an indication of the way children perceive the outside world, they help adults establish communication with children and overcome the difficulties faced by children (Artut, 2002). Drawings provide important clues about individuals' mental development, perceptions, attitudes, emotions, and way of thinking.

Considering the argument that writing skills are not necessary for drawing skills, it can only be used to evaluate primary school students, even younger children, but it has not sufficient significance to assess older students or adults (Reinisch, Krell, Hergert, Gogolin, & Krüger, 2017). Therefore, picture drawings can be used effectively in determining the perceptions of the students in the younger age group with respect to scientists and understanding the level of these perceptions. In this regard, Chambers (1983) developed the Draw Draw A Scientist Test-DAST " scale. The scale was developed in order to detect the perceptions of scientists in primary and pre-school students who have difficulty in expressing themselves verbally and in writing. In his study, Chambers (1983) applied the DAST to 4807 students in total that comprised of students from kindergarten to the 5th grade but the 2nd and 3rd graders formed a major part of the sample. He grouped the collected drawings into the seven following categories: 1) Lab clothing; 2) Glasses; 3) Characteristics of their heads (mustache, beard, facial expressions, and so on); 4) Research symbols; 5) Science symbols (book, notes, and so on); 6) Technological products; and 7) Related objects (formulas, taxonomic rankings, and so on). Thus, Chambers (1983) concluded that students perceive scientists as "older men, wearing glasses and a white lab coat, who have messy hair, a beard, and work in an environment covered with chemical." Moreover, Chambers (1983) also indicated that some students did draw female scientists. Among the collected data, it was discovered that younger students had drawn beakers, volumetric flasks, and various chemical objects as research symbols, whereas older students had drawn more complicated research symbols such as computers, telescopes, and microscopes.

It is noteworthy that the stereotypical images of scientists expressed in Champers' (1983) study are maintained in other studies conducted in later years. Newton and Newton (2008) stated in their studies in which 1000 students aged between 4 and 11 were participated that the students had a perception of middle-aged and bearded scientists wearing lab coats. Walls (2012) collected the data both via

interviews and drawings in his study in which opinions of the third grade students on the nature of science and the scientist were examined. He stated that the two data groups were parallel to each other and that the majority of the students described the scientist as an old man wearing a lab coat and glasses. There are also studies on how the students describe not only the scientists but also different occupational groups. Losh, Wilke and Pop (2008) for example, asked 1st, 3rd and 5th grade students to draw vet and teacher pictures in addition to a scientist. The students drew teachers mostly as women and scientists as men. Given that the social environments affect the students' thoughts and perceptions, it can be stated that their perceptions towards occupations are shaped accordingly. In this case we can say that it can affect students' forward career plans.

Although DAST is often used for lower grades and age levels, it is possible to see different studies involving higher grades such as secondary and higher education in the literature. Meyer, Guenther ve Joubert (2018) included first-year students from different faculties (Faculty of Arts, Faculty of Agriculture, Faculty of Arts and Social Sciences) in his studies. It is stated that they draw a scientist as a man wearing glasses and a lab coat, who is at an uncertain age and surrounded by laboratory equipment, and this stereotyped perception is mostly drawn by the students of the Faculty of Arts and Social Sciences. It can be stated that this supports the view that students' perception of scientists affects their career plans for science. Furthermore, it is stated in the studies in the literature that there is a perception for a scientist who carries out the studies in an enclosed space such as a laboratory (Finson, Beaver, & Cramond, 1995; Nuhoğlu and Afacan, 2011; Yontar Toğrol, 2000; Walls, 2012). However, Et and Kabataş Memiş (2017) stated in their studies in which the perception of five-year-old students with respect to scientists was examined that students perceived scientists as individuals also working in environments other than the indoor spaces.

It is very important to create a correct perception of science and scientists for students. Because it is stated in the literature that students' perceptions of scientist affect their career plans in this field (Miele, 2014; Toğrol, 2013; Meyer, Guenther and Joubert 2018; Özgelen, 2012). For this, it is necessary to determine these perceptions of students from the first stages of education and to provide a science education considering the perceptions detected. In order to achieve such a goal and obtain more generalized results, it is quite important to reach larger research groups. It is not much possible to achieve the specified objectives by smaller research groups. Because of all these reasons, the object of the study is to determine the perceptions of 1862 students of the 1st, 2nd, 3rd and 4th grade with respect to scientists.

3. Method

3. 1. Research model

In this study descriptive design was used for deremining elementary school students' perceptions of scientists. According to McMillan and Schumacher (2006), descriptive research design is defined as; "Descriptive design are used to summarize the current or past status of somethings. This type of research simply describes achievement, attitudes, behaviors, or other characteristics of a group of subjects. A descriptive study asks What is? or What was?. It reports things the way they are or were. There is no intervention."

3. 2. Sample

This study was conducted with 1800 students studying in the 1st, 2nd, 3rd, and 4th grades at three different elementary schools (AFD, CO, and T Elementary Schools) in the Kastamonu city center during the fall and spring semesters of the 2016-2017 academic year. The purposive sampling method was used while creating the sample. The reason for using the purposive sampling method is that it makes it possible to obtain detailed data about the purpose of this study (Patton, 2014). The information about this study's participants is given in Table 1.

Table 1. *The information about the students participating in this study*

Grades	AFD Elementary School			CO Elementary School			T Elementary School			Total
	F*	M*	U*	F*	M*	U*	F*	M*	U*	
1st Grade	67	80	14	68	83	6	81	80	1	480
2nd Grade	74	66	-	67	68	-	84	91	-	450
3rd Grade	74	80	-	87	79	-	70	81	-	471
4th Grade	80	75	1	59	70	2	72	100	2	461
Total	295	301	15	281	300	8	307	352	3	1862

Note: F*= Female, M*=Male, U*=Unknown

3. 3. Data collection tools

The DAST, which was developed by Chambers (1983), was used to collect data in order to determine how students perceive science and scientists. Due to this test, the drawings of students who belong to a younger age group can be used effectively to determine their perceptions of scientists and the level of the said perceptions. Questions such as "Who is a scientist?" "What does a scientist do?" "Where does a scientist work?" were asked to the students without providing any information about science or scientists and thus, urging them to think about scientists and make some drawings accordingly.

3. 4. Applications Process

We briefly summarized the research to the students and they participated in the study voluntarily. We began by handing out 35x25 cm drawing papers and a set of 12 colorful crayons to the students. Then, we prompted the students to think about the subject by asking them questions such as "Who is a scientist? What does a scientist do? Where does a scientist work?" Subsequently, we asked the students to draw their thoughts on paper. Researchers, who were present in the same classroom while the students were making their drawings, provided technical help to the students (such as providing them with crayons, pencil sharpeners, and erasers). Once the drawings were completed, the researchers spoke with each student face-to-face and asked them to describe what they had drawn. While the students were describing their drawings, the researchers took short notes to prevent possible misunderstandings.

3. 5. Data analysis

We analyzed the content of the data collected via the DAST drawings of the students. The purpose of the content analysis was to interpret the data and create groups based on similar concepts and themes (Çepni, 2012). In this regard, we created themes such as (1) gender characteristic, (2) physical characteristics, (3) working environment, (4) alternative symbols, and (5) research symbols. We conducted the analysis by considering the mentioned themes and creating appropriate codes accordingly.

4. Findings

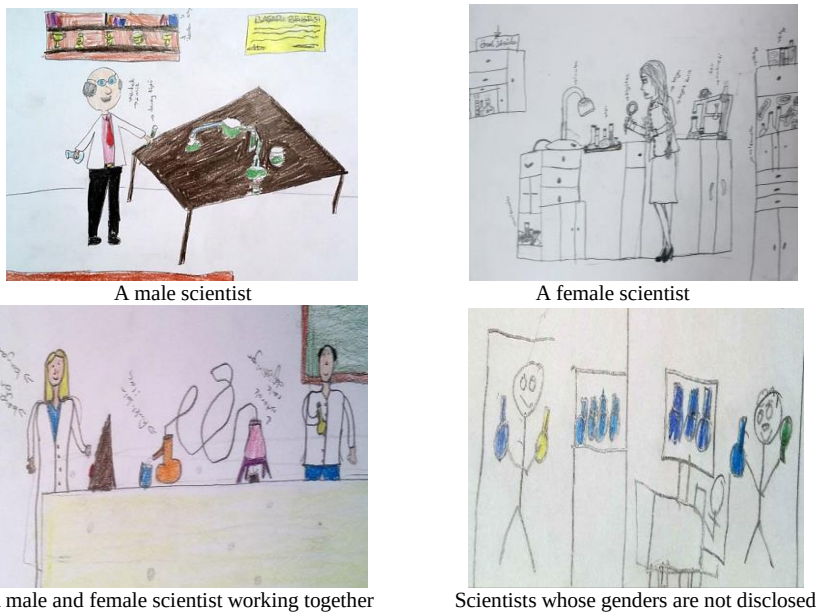
4. 1. Gender characteristics of scientists

Students' perceptions of scientists' gender characteristics are given according to their grade levels in Table 2. When we look at the table, we see that students mostly drew male scientists (f = 1140), followed by female scientists (f = 350), male and female scientists working together (f = 272) and scientists whose gender is not specified (f = 109). When we examine each grade level separately, we see that students mostly drew male scientists ($f_{1.sınıf}$ = 267, $f_{2.sınıf}$ = 263, $f_{3.sınıf}$ = 306, $f_{4.sınıf}$ = 295). The table also shows that the 1st graders tended to draw more female scientists ($f_{1.sınıf}$ = 116). The number of drawings portraying female and male scientists working together is close in numbers at almost each grade level.

Table 2. *Gender characteristics*

Gender	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Male	276 (57.5)	263 (58.4)	306 (64.9)	295 (63.9)	1140 (61.2)
Female	116 (24.1)	91 (20.2)	67 (14.2)	76 (16.4)	350 (18.7)
Male and Female Together	65 (13.5)	72 (16)	66 (14)	69 (14.9)	272 (14.6)
Not Disclosed	23 (4.7)	26 (5.7)	48 (10.1)	12 (2.6)	109 (5.8)

Figure 1 shows sample drawings of a male scientist, female scientist, a male and female scientist working together and scientists whose genders have not been disclosed.



A male scientist | A female scientist

A male and female scientist working together | Scientists whose genders are not disclosed

Figure 1. *Drawing samples showing scientists' gender characteristics*

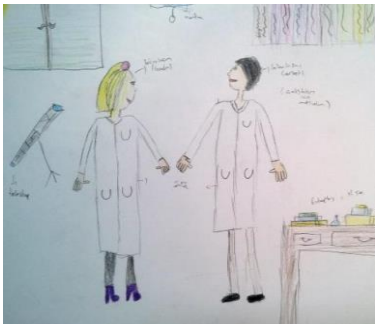
4. 2. Scientists' physical characteristics

4.2.1. Scientists' characteristic clothing. As it can be seen in Table 3, scientists' clothes according to the student's grade level are determined as casual at every grade level. In the drawings, the 2nd graders drew the most number of casual clothes (f = 281), followed by the 1st graders (f = 271), 3rd graders (f = 251), and 4th graders (f = 175). Moreover, among the students, the largest number of 4th graders (f = 136) portrayed scientists wearing lab coats, followed by the 3rd graders (f = 55), 2nd graders (f = 36), and 1st graders (f = 27). When we examined the students' drawings, we saw that scientists were depicted as wearing some protective clothing to protect themselves during their studies (For example, scientists dealing with flammable materials wore fireproof clothes and scientists dealing with explosives wore helmets). Within the context of this study, the aforementioned clothes are coded as "special clothing/helmet." Accordingly, the 4th graders drew the most number of scientists wearing special clothing/helmets (f = 32). In addition to these clothes, the scientists were also depicted wearing scientist clothes, spacesuits (f = 31), and suits (f = 15). Moreover, 27% of the students (f = 503) also made drawings where the clothes of scientists were not disclosed. In these drawings, scientists are depicted as stick figures. Such depictions were the most common among the 1st graders (f = 159), followed by the 3rd graders (f = 118), 2nd graders (f = 114), and 4th graders (f = 112). Sample drawings showing the clothes of scientists are shown in Figure 2.In the research 345 pre-service teachers were involved.

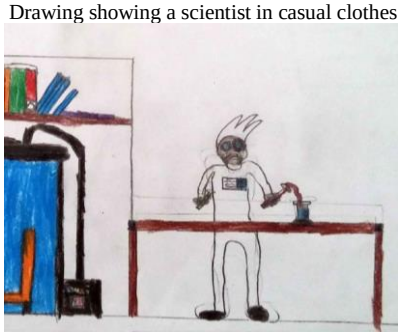
Table 3. *Scientists' characteristic clothing*

Characteristics of Their Clothing	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Casual	271 (56.4)	281 (62.4)	251 (53.2)	175 (37.9)	978 (52.5)
Lab Coat	27 (5.6)	36 (8)	55 (11.6)	136 (29.5)	254 (13.6)
Special Clothing/Helmet	10 (2)	24 (5.3)	37 (7.8)	32 (6.9)	103 (5.5)
Spacesuit	9 (1.8)	2 (0.4)	4 (0.8)	16 (3.4)	31 (1.6)
Suit	_	5 (1.1)	7 (1.4)	3 (0.6)	15 (0.8)
Not Disclosed	159 (33.1)	114 (25.3)	118 (25)	112 (24.2)	503 (27)

Drawing showing a scientist in casual clothes



Drawing showing a scientist in a lab coat



Drawing showing a scientist in special clothing

Drawing showing a scientist in a spacesuit

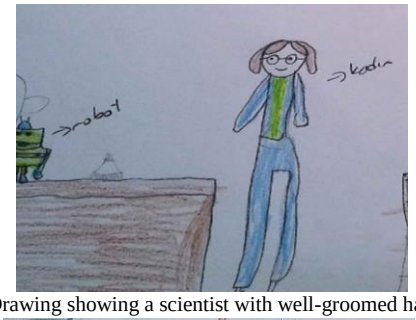
Figure 2. *Drawing samples showing scientists' characteristic clothing*

4.2.2. Characteristics of scientists' heads. Results showing the characteristics of scientists' heads are shown in Table 4 When we examine the table, we see that students generally depicted scientists with well-groomed hair (f = 545). With regard to the characteristics of scientists' heads, the drawings depict scientists mostly with messy hair (f = 435), bald (f = 303), long hair (f = 242), and spiked hair (f = 186). Students also drew scientists with a mustache (f = 57) and beard (f = 38). The 2nd graders drew the highest number of scientists with well-groomed hair (f = 196), the 1st graders drew the highest number of scientists with messy hair (f = 174) and long hair (f = 105), the 3rd graders drew the highest number of bald scientists (f = 124), and the 4th graders drew the highest number of scientists with spiked hair (f = 54). The 3rd graders drew the most number of scientists with a mustache (f = 24) and a beard (f = 22). According to the findings, students at different grades perceive the characteristics of scientists' heads differently.

Table 4. *Characteristics of their heads*

Characteristics of Their Heads	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Groomed Hair	39 (8.1)	196 (43.5)	136 (28.8)	174 (37.7)	545 (29.2)
Messy Hair	174 (36.2)	49 (10.8)	81 (17.1)	131 (28.4)	435 (23.3)
Bald	13 (2.7)	93 (20.6)	124 (26.3)	73 (15.8)	303 (16.2)
Long Hair	105 (21.8)	50 (11.1)	67 (14.2)	20 (4.3)	242 (12.9)
Spiked Hair	41 (8.5)	38 (8.4)	53 (11.2)	54 (11.7)	186 (9.9)
Mustache	6 (1.2)	9 (2)	24 (5)	18 (3.9)	57 (3)
Beard	-	4 (0.8)	22 (4.6)	12 (2.6)	38 (2)

Figure 3 shows sample drawings of scientists with well-groomed hair, bald, messy hair, long hair, spiked hair, mustache, and beard.



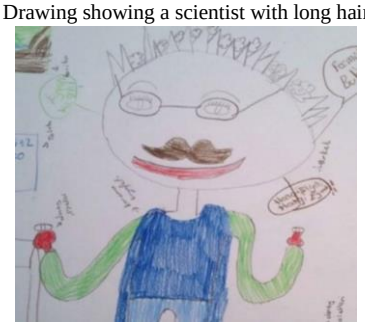
Drawing showing a scientist with well-groomed hair


Drawing showing a bald scientist


Drawing showing a scientist with messy hair


Drawing showing a scientist with long hair


Drawing showing a scientist in spiked hair


Drawing showing a scientist with a mustache

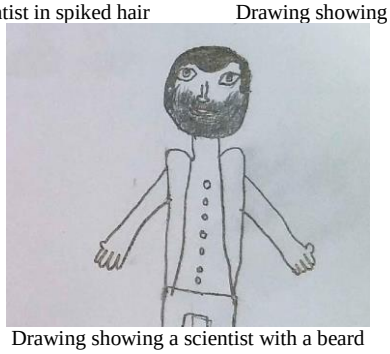

Drawing showing a scientist with a beard

Figure 3. *Drawing samples showing characteristic of scientists' heads*

4.2.3. Scientists' facial characteristics. Students also depicted different facial expressions in their scientist drawings. Among the different facial expressions, the 4th graders drew the most number of scientists with a "happy" face (n = 363), the 3rd graders drew the most number of scientists with a "thoughtful" face (f = 60), the 2nd graders drew the most number of scientists with a "nervous/serious" face (f = 46), the 3rd graders drew the most number of scientists with a "surprised" face (f = 17), and the 4th graders drew the most number of scientists with an "upset" face (f = 8). Moreover, we coded those drawings where the scientists are depicted as facing away as "not disclosed." The 3rd graders drew the most number of scientists whose facial expressions are "not disclosed." Findings showing the students' perceptions of scientists' facial characteristics are shown in Table 5 and Figure 4 consists of examples showing the different facial expressions.

Table 5. *Facial characteristics*

Facial Characteristics	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Happy	339 (70.6)	276 (61.3)	266 (56.4)	363 (78.7)	1244 (66.8)
Thoughtful	28 (5.8)	57 (12.6)	60 (12.7)	30 (6.5)	175 (9.3)
Nervous/Serious	5 (1)	46 (10.2)	22 (4.6)	3 (0.6)	76 (4)
Surprised	15 (3.1)	8 (1.7)	17 (3.6)	16 (3.4)	56 (3)
Upset	6 (1.2)	3 (0.6)	6 (1.2)	8 (1.7)	23 (1.2)
Not disclosed	86 (17.9)	58 (12.8)	98 (20.8)	35 (7.5)	277 (14.8)

Figure 3 shows sample drawings of scientists with well-groomed hair, bald, messy hair, long hair, spiked hair, mustache, and beard.

Drawing showing a happy scientist

Drawing showing a serious scientist

Drawing showing a thoughtful scientist

Drawing showing a surprised scientist

Drawing showing an upset scientist

Drawing showing a scientist with undisclosed facial expression

Figure 4. *Drawing samples showing scientists' facial expressions*

4.2.4. Scientists' accessories. Students indicated in their drawings that scientists use accessories. In the following Table 6, scientists are mostly depicted as wearing "eyeglasses." Moreover, among the students, the largest number of 4th graders (n = 98) indicated that scientists wear eyeglasses, followed by the 3rd graders (f = 67), 2nd graders (f = 41), and 1st graders (f = 30). Students' drawings depicted that hats are the second most common accessory used by scientists following the eyeglasses. When we examined the students' drawings, we saw that the highest number of scientists wearing "hats" were drawn by the 1st graders (f = 31). In accordance with the increase in the number of drawings depicting female scientists, there are drawings showing scientists wearing hairpins and necklaces. The highest number of scientists wearing "hairpins" was drawn by the 4th graders (f = 18) and the highest number of scientists wearing "necklaces" were drawn by the 3rd graders (f = 7). On the other hand, there are also drawings showing scientists wearing "ties/bow ties" (f = 41), belts (f = 19), masks (f = 13), and carrying bags (f = 5). The results showing the scientists' accessories are shown in Table 6. Sample drawings showing the scientists using the said accessories are shown in Figure 5.

Table 6. *Accessories*

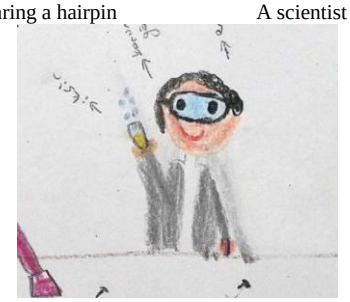
Accessory	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Glasses	30 (6.2)	41 (9.1)	67 (14.2)	98 (21.2)	236 (12.6)
Hat	31 (6.4)	8 (1.7)	15 (3.1)	22 (4.7)	76 (4)
Hairpin	12 (2.5)	13 (2.8)	11 (2.3)	18 (3.9)	54 (2.9)
Tie/Bow Tie	8 (1.6)	4 (0.8)	13 (2.7)	16 (3.4)	41 (2.2)
Belt	_	2 (0.4)	5 (1)	12 (2.6)	19 (1)
Mask	_	3 (0.6)	4 (0.8)	6 (1.3)	13 (0.6)
Necklace	1 (0.2)	1 (0.2)	7 (1.4)	3 (0.6)	12 (0.6)
Handbag	_	3 (0.6)	1 (0.2)	1 (0.2)	5 (0.2)
Not Disclosed	385 (80.2)	362 (80.4)	361 (76.6)	298 (64.6)	1406 (75.5)

A scientist wearing eyeglasses

A scientist wearing a hat

A scientist wearing a hairpin

A scientist wearing a tie



A scientist wearing eyeglasses while working

Figure 5. *Characteristics of scientists' accessories*

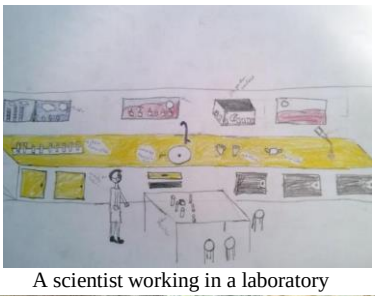
4. 3. Scientists' working environment

Students indicated that scientists work in different environments according to their grades (see Table 7). Students depicted "laboratories" as the most common working environment of scientists. According to these drawings, the laboratory environment was most depicted by the 2nd graders (f = 258), followed by the 4th graders (f = 184), 3rd graders (f = 178), and 1st graders (f = 177). When we examined the drawings, we saw that there were also drawings depicting scientists working outside, in nature or a natural environment instead of a closed area. The 1st graders depicted the highest number of scientists' working environment as "nature" (f = 135), the 3rd graders depicted the highest number of scientists' working environment as a science room, science center, and science house (f = 68), and the 4th graders depicted the highest number of scientists' working environment as an "office" (f = 78). A different working environment that is shown in the drawings is the "outer space" (f = 60). In addition to the aforementioned working environments, the students drew scientists mostly as working

from home (f = 148), at a "factory/workshop" (f = 28), "classroom/school" (f = 12), "hospital/surgery" (f = 7), "submarine/underground" (f = 5), "observatory" (f = 4), and "mosque/minaret" (f = 2). Moreover, there are also some drawings where the working environment of scientists is not depicted. The sample drawings showing the scientists' working environment are shown in Figure 6.

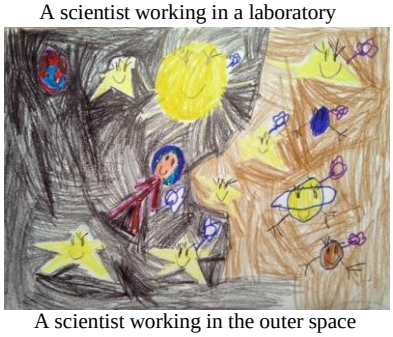
Table 7. *Working environment*

Working Environment	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Laboratory	177 (36.6)	258 (57.3)	178 (22.7)	184 (39.9)	797 (48.8)
Nature	135 (28.1)	91 (20.2)	92 (19.5)	46 (9.9)	364 (19.5)
Science Room Science Center Science House	11 (2.2)	38 (8.4)	68 (14.4)	38 (8.2)	155 (8.32)
House	39 (8.1)	27 (6)	82 (17.4)	-	148 (7.9)
Office	23 (4.7)	8 (1.7)	8 (1.6)	78 (16.9)	117 (6.2)
Outer Space	22 (4.5)	14 (3.1)	6 (1.2)	18 (3.9)	60 (3.2)
Factory/Workshop	28 (5.8)	-	-	-	28 (1.5)
Classroom/School	1 (0.2)	3 (0.6)	4 (0.8)	4 (0.8)	12 (0.6)
Hospital/Surgery	-	-	4 (0.8)	3 (0.6)	7 (0.3)
Submarine/Underground	-	-	4 (0.8)	1 (0.2)	5 (0.2)
Observatory	-		3 (0.6)	1 (0.2)	4 (0.2)
Mosque/Minaret	-	-	2 (0.4)	-	2 (0.1)
Non-Located	58 (12)	6 (1.3)	21 (4.4)	161 (34.9)	246 (13.2)

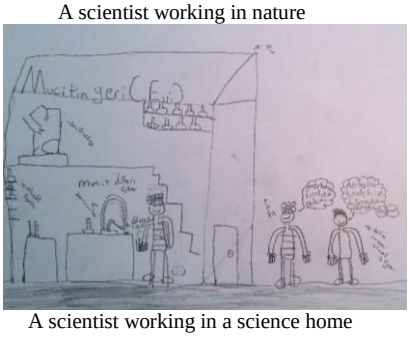


A scientist working in a laboratory

A scientist working in nature



A scientist working in the outer space



A scientist working in a science home

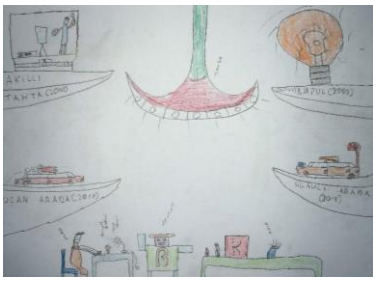
Figure 6. *Drawing samples showing scientists' working environments*

4. 4. Alternative Symbols

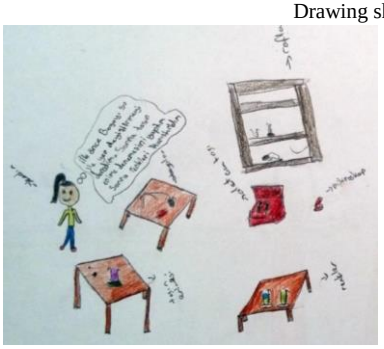
The objects present in the scientists' working environments were classified as alternative symbols within the context of this study. In total, "lamps" are the most depicted symbols (f = 162), followed by "speech bubbles" (f = 119), and "warning symbols/signs" (f = 97). In addition, there are alternative symbols drawn by the students such as "camera/alarm" (f = 39), "watch" (f = 28), and "magnifying glass/binoculars" (f = 21). There are also symbols such as "signboards, antennas/satellites, awards, scales, solar panels, fire extinguisher, oxygen cylinder, projection, protectors, stethoscope/first-aid bags, elevators/generators, and magnet/thermometer" in addition to the aforementioned symbols. Moreover, as the grade level increases, the variety of the alternative symbols used by the students in their drawings also increases. The information pertaining to the aforementioned findings are shown in Table 8 and students' drawings showing the alternative symbols are shown in Figure 7.

Table 8. *Alternative symbols*

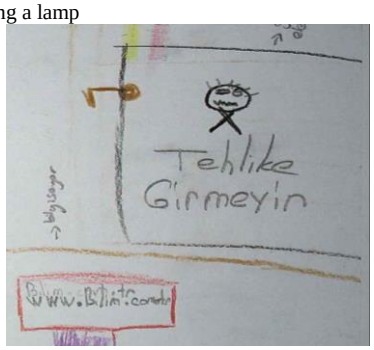
Alternative Symbols	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Lamp	20 (4.1)	27 (6)	50 (10.6)	65 (14)	162 (8.7)
Speech/Thought Balloons	-	9 (2)	58 (12.3)	52 (11.2)	119 (6.3)
Warning Symbols Warning Signs	4 (0.8)	48 (10.6)	25 (5.3)	20 (4.3)	97 (5.2)
Security Camera/Alarm	-	1 (0.2)	25 (5.3)	13 (2.8)	39 (2)
Watch	-	7 (1.5)	6 (1.2)	15 (3.2)	28 (1.5)
Magnifying Glass/Binoculars	-	5 (1.1)	5 (1)	11 (2.3)	21 (1.1)
Signs	-	5 (1.1)	2 (0.4)	9 (1.9)	16 (0.8)
Antenna/Satellite	-	4 (0.8)	2 (0.4)	8 (1.7)	14 (0.7)
Awards	-	2 (0.5)	2 (0.4)	8 (1.7)	12 (0.6)
A Pair of Scales	-	-	-	7 (1.5)	7 (0.3)
Sun/Solar Panel	-	2 (0.5)	1 (0.2)	3 (0.6)	6 (0.3)
Fire Extinguisher Oxygen Cylinder	-	-	1 (0.2)	4 (0.8)	5 (0.2)
Projection	-	1 (0.2)	2 (0.4)	2 (0.4)	5 (0.2)
Protectors	-	-	-	4 (0.8)	4 (0.2)
Stethoscope/First-Aid Bag	-	-	1 (0.2)	1 (0.2)	2 (0.1)
Elevator/Generator	-	-	1 (0.2)	1 (0.2)	2 (0.1)
Magnet/Thermometer	-	-	-	1 (0.2)	1 (0.05)



Drawing showing a lamp



Drawing showing a speech bubble



Drawing showing a warning sign

Figure 7. *Sample drawings showing the alternative symbols*

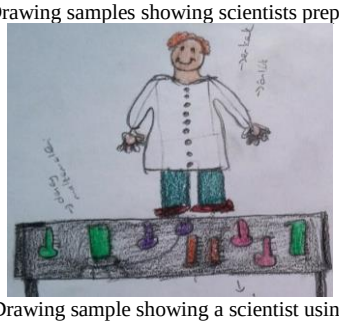
4. 5. Research symbols

Table 9 shows a grade level comparison of the students' perceptions of the research symbols used by scientists. When we examine the drawings to compare the research symbols, we see that the most commonly depicted research symbols by the students are "mixture/elixir/formula" (f = 578), "test tube" (f = 515), volumetric flask (f = 443), "experimental setup" (f = 413). There are also other research symbols depicted by the students such as "robot" (f = 357), "outer space machine" (f = 120), and "rocket" (f = 94). We coded the drawings where there are not any of the research symbols as "not disclosed." We see that non-disclosed research symbols were mostly drawn by the 1st graders (f = 152). Table 9 shows the results regarding research symbols and drawing samples are given in Figure 8.

Table 9. *Research symbols*

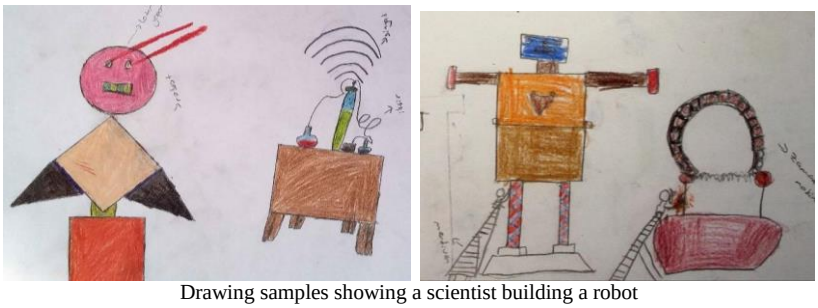
Research Symbols	1st Grade f %	2nd Grade f %	3rd Grade f %	4th Grade f %	Total f %
Mixture/Elixir/Formula	149 (31)	192 (42.6)	75 (15.9)	162 (35.1)	578 (31)
Test Tube	92 (19.1)	128 (28.4)	142 (30.1)	153 (33.1)	515 (27.6)
Volumetric Flask	72 (15)	83 (18.4)	167 (35.4)	121 (26.2)	443 (23.7)
Experimental Setup	49 (10.2)	63 (14)	197 (41.8)	104 (22.5)	413 (22.1)
Robot	74 (15.4)	86 (19.1)	150 (31.8)	47 (10.1)	357 (19.1)
Outer Space Machine	84 (17.5)	14 (3.1)	70 (14.8)	60 (13)	228 (12.2)
Conical Flask	35 (7.2)	32 (7.1)	65 (13.8)	60 (13)	192 (10.3)
Beaker	40 (8.3)	16 (3.5)	54 (11.4)	48 (10.4)	158 (8.4)
Technological Apparatus	-	55 (12.2)	14 (2.9)	51 (11)	120 (6.4)
Research/Project/Notes	-	34 (7.5)	-	-	34 (1.8)
Car/Bicycle	17 (3.5)	19 (4.2)	36 (7.6)	23 (4.9)	95 (5.1)
Rocket	27 (5.6)	30 (6.6)	21 (4.7)	16 (3.4)	94 (5)
Telescope/Microscope	8 (1.6)	22 (4.8)	18 (3.8)	33 (7.1)	81 (4.3)
Flower/Tree	15 (3.1)	23 (5.1)	20 (4.2)	21 (4.5)	79 (4.2)
Flying balloon/Flying chair Flying car/Flying Shoe	-	9 (2)	5 (1)	30 (6.5)	44 (2.3)
Lamp/Satellite	-	7 (1.5)	-	34 (7.3)	41 (2.2)
Animal	10 (2)	5 (1.1)	10 (2.1)	12 (2.6)	37 (1.9)
Food/Drink	-	6 (1.3)	-	28 (6)	34 (1.8)
Airplane/Helicopter	-	6 (1.3)	-	11 (2.3)	17 (1.9)
Painting/Music	3 (0.6)	6 (1.3)	1 (0.2)	6 (1.3)	16 (0.8)
Electrical Panel Electric Cables	-	-	-	10 (2.1)	10 (0.5)
House/Tower/Cabin	-	3 (0.6)	-	-	3 (0.1)
Patient/Vaccination	-	2 (0.4)	3 (0.6)	3 (0.6)	8 (0.4)
Mirror	1 (0.2)	-	2 (0.4)	1 (0.2)	4 (0.2)
Wind Rose	-	-	2 (0.4)	1 (0.2)	3 (0.1)
The Shape of the World	-	-	3 (0.6)	-	3 (0.1)
Bridge Construction	-	-	1 (0.2)	1 (0.2)	2 (0.1)
Thermometer	1 (0.2)	-	-	-	1 (0.05)
Volcano	1 (0.2)	-	-	-	1 (0.05)
Bones	-	-	1 (0.2)	-	1 (0.05)
Weapon	-	-	-	1 (0.2)	1 (0.05)
Funeral	-	-	-	1 (0.2)	1 (0.05)
Not Disclosed	152 (31.6)	66 (14.6)	52 (11)	29 (6.2)	299 (16)


Drawing samples showing scientists preparing mixtures, elixirs, and experimental setups



Drawing sample showing a scientist using a conical flask, volumetric flask

Drawing sample showing a scientist using a telescope



Drawing samples showing a scientist building a robot

Figure 8. *Sample drawings showing the research symbols*

5. Discussion and Conclusion

Although primary school (1st, 2nd, 3rd and 4th grade) students studying at different schools in northwest of Turkey have generally drawn stereotyped scientists, promising drawings have been observed as well. When the studies in the literature are examined, we can say that the factors that define a scientist are in the form of an old man wearing a lab coat and glasses, who works in an enclosed space (Champers, 1983; Walls, 2012). In our study, although the students included female scientists in their drawings, it is consistent with the literature that more than half of the students drew male scientists (Mason, Kahle, & Gardner, 1991; Yontar Togrol, 2000; Et & Kabataş Memiş, (2017); Anastassios & Athina, 2018). At this point, Losh, Wilke and Pop (2008) has stated that the drawing of a scientist as white males in general creates a negative perception as "not like me" especially by female students. As a result of this, negative attitude towards science occurs and consequently a science-related career plan in any field is abandoned. The most commonly described accessory is the protective laboratory glasses as the students have a perception of scientists who conduct their studies in a laboratory.

It is stated in the literature that the descriptions of scientists wearing lab coats and glasses are more frequent (Finson, Beaver & Cramond, 1995; Nuhoğlu & Afacan, 2011). However, in our study, it was found that the use of lab coat (%13,6) and glasses (%12,6) as the clothes characteristics of scientist was drawn at lower rates as compared to the daily clothes (%52,5). In addition to the specified clothes characteristics, it can be said that there is a perception in the students' drawings that the scientists can wear special clothes such as an astronaut costume in accordance with their working field. Students describe stereotyped images of scientists who devote their lives to be useful to humanity, cannot take care of themselves due to their hard work, have therefore messy hair and beards, and are bald as they are old (Champers, 1983; Christidou, Bonoti, & Kontopoulou, 2016; Finson, 2002; Karaçam, 2016; Turgut, Öztürk, & Eş, 2017). At this point, our study differs from the literature and it is noteworthy that the scientists with well-groomed hair (%29,2) are more frequently drawn. On the contrary, it can be said that stereotyped images of scientist who has messy hair (%23,3) and bald (16,2) are continued to be drawn. In the studies in which the perceptions of five years of age (Et & Kabataş Memiş, 2017) are examined, it was stated that the majority of the students draw a scientist with a happy face. Similar to the findings mentioned in our study, it can be said that more than half of the students draw happy scientists (%66,8).

It can be said that students' stereotyped perceptions of scientist who work in enclosed and indoor spaces (Champhers, 1982; Newton, Newton, 2008; Yontar Toğrol, 2000) such as laboratories are higher than their perceptions of scientist working outdoors such as space and nature (Christidou, Bonoti & Kontopoulou, 2016; Deniş Çeliker, Erduran Avcı, 2015; Erten, Kıray, & Şen-Gümüş, 2013). In our study, it was found that the stereotyped perceptions of the students with respect to the indoor spaces such as laboratory (%48,8), science room/science center/science house (%8,3) were more frequent. Although almost half of the students describe the working environment of the scientist as an enclosed environment such as a laboratory, it is seen that the scientist may work in different environments such as nature, space and home. It can be said that the fact that students drew different environments in their drawings is an important indicator that some stereotypes are broken. Students have a perception that the scientist has power beyond the power of ordinary people; they work for their benefit; and that they have weak social relations (Mead & Metraux, 1957; Christidou, Bonoti &

Kontopoulou, 2016). Students draw scientists as working alone in enclosed spaces due to this perception.

Within the scope of DAST, students have drawn research symbols related to the working fields of scientists. These symbols differ depending on the areas of expertise and the scientific process skills of the scientists. Therefore, it is possible to say that the student drawings for this theme vary. Glassware such as test tubes and beakers; dangerous chemical mixtures; technological instruments such as robots and machines; and objects such as microscopes and telescopes are the stereotyped items used by the scientists in their studies (Champhers, 1983; Mead & Metraux, 1957; Miele, 2014; Turgut, Öztürk & Eş; 2017). Given the research symbols described, it can be mentioned that students have a perception of scientist who conduct experiments mostly on physics or chemistry in the laboratory. In our study findings parallel to the literature were obtained. In addition to the stereotyped symbols such as experimental devices of glassware, students drew various technological instruments, telescopes and microscopes, and objects such as animals, patients/vaccines, food/beverages as research symbols. Given the research symbols drawn by the students, it can be said that students have a perception that scientists follow a certain scientific process. This can be said to be a stereotyped perception of scientist. Because the physics of Einstein, the most well-known name of modern science, is not based on experiments in laboratories, but on thought experiments (Erten, Kıray & Şen-Gümüş, 2013). In addition, students have drawn research symbols such as flying chairs/flying cars/flying shoes. This may be an indication that students perceive scientists as the ones who keep up with the times, update themselves and renew themselves.

In this study, perceptions of the 1st, 2nd, 3rd and 4th grade students with respect to scientists were examined. It can be said that the stereotyped perception of scientist such as a man who works in an enclosed space such as laboratory, wears white coat and glasses and mostly works in the field of physics or chemistry is maintained (Anastassios & Athina, 2018; Champers, 1982; Losh, Wilke and Pop, 2008; Newton, Newton, 2008; Yontar Toğrol, 2000). However, it can be said that there are drawings in which rate of female scientists is increased, the scientists work out of laboratory such as nature and space and the scientists are the ones who wear daily clothes, are well-groomed, good-humored and have a social life. In addition, it can be said that students do not separate scientists from daily life and do not see them as strange, different or more intelligent creatures. It can be stated that the fact that students do not separate the scientist from themselves or the people around them may affect their interest in science and have a positive effect on their forward career plans related to science. Because it is stated in the literature that the students' perceptions of scientist and their attitudes towards science affect their forward career plans (Buldu, 2006; Finson, 2002).

In our study, primary school students' perceptions of scientist were examined. However, it is an issue of concern how the students' perceptions of scientist, their attitudes towards science and their professional careers will be built in the subsequent educational levels. Therefore, it is recommended to conduct long-term longitudinal studies which focus on a particular group of students and examine how their perceptions of scientists or science change at subsequent educational levels. This issue can be addressed, especially from the preschool time, the early life of the educational background. It is also stated that students' perceptions of scientist are affected by various factors such as books, cartoons and teachers. Studies on how these factors affect students' perceptions of scientist can be conducted. In particular, given that the students spend their most of time with their teachers, it is important to perform studies in which the perceptions of students and teachers with respect to science and scientist are addressed.

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