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Middle School Students' Perceptions of Scientists and Views About to Become a Scientist

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Abstract

It is important to explore children's perceptions related to scientists for preventing their lack of interest in science and avoidance of science careers. This study aims to reveal middle school students' images of scientists, with an analysis of how those images may be influenced by middle school science textbooks currently use in Turkey. It was also examined students' opinions related to becoming a scientist. The study is based on a qualitative research methodology. The sample consists of 98 students from a middle school (5th, 6th, 7th, and 8th grade). The data was gathered by four science textbooks, the Draw a Scientist Test (DAST) and an open-ended questionnaire. The findings showed that most of the middle school students think that scientists as men, happy, wearing lab coats and glasses, working individually in indoor places. Albert Einstein and Isaac Newton were drawn as the most famous scientists. The images of scientists in the science textbooks were mostly men. On the other side, more than half of the students were not sure or not eager to be scientists for their future careers because of negative thoughts on scientific studies and not matching their own characters and the characters that scientists should have.

Introduction

Science and scientists' images that people have are one of the indicators for individuals' perceptions of scientists and their roles in society (Hatisaru & Murphy, 2019; Medina-Jerez, Middleton, & Orihuela-Rabaza, 2011; Meyer, Guenther, & Joubert, 2019). These images also show that people's attitudes towards science, interest in and learning of science, and understanding of science (Chionas & Emvalotis, 2021; El Takach & Yacoubian, 2020; El Takach & Al Tobi, 2021; Emvalotis & Koutsianou, 2018). It is known that if students have negative views, images, and stereotypical perceptions of scientists, this could result in negative attitudes towards science (Buldu, 2006) and consequently influence their study and achievement in science, and their career choice (Britner, 2008). Because of this relation, analyzing students' images related to scientists have importance in the literature.

Mead and Metraux (1957) were the first researchers who investigate high school students' essays concerning images of scientists. In the related literature, there is a steady increase in studies that examines students' images and perceptions of scientists (e.g., Akçay, 2011; Meyer et al., 2019; Sharma & Honan, 2020). One of the most

common ways to analyze students' images of scientists is using the Draw-a-Scientist Test (DAST) developed by Chambers (1983). He developed the test to evaluate students' scientific literacy by asking them to draw a scientist and then analyzing the images (Meyer et al., 2019, p. 2). The DAST has its own properties such as it is possible to use it alone or with other data gathering tools like interviews or observations (Avraamidou, 2013) and it is also able to cope with the limitations of written or oral test (Baldu, 2006), so can be used for younger students.

Students Identify the Images of Scientists

The DAST has been used in many research focused on children (Emvalotis & Koutsianou, 2018), pre-service or in-service teachers (Milford & Tippett, 2013; Subramaniam, Harrell, & Wojnowski, 2013). Furthermore, many studies have been conducted to reveal whether students' images of scientists differ according to gender, age, and grade level. For example, Chambers (1983) stated that students drew scientists as stereotypical perceptions such as people with aprons, beards, wearing glasses, long messy hair, and working with laboratory equipment. In terms of gender, Akcay (2011) found that elementary and secondary students perceived scientists as males. Christidou, Hatzinikita and Samaras (2012) also reached that a typical scientist is male. A similar result was found in the meta-analysis, spanning 5 decades of Draw-A-Scientist studies, examined U.S. (Miller, Nolla, Eagly, & Uttal, 2018).

There are a lot of studies that concluded that many people's images and perceptions of scientists are stereotypical (Meyer et al., 2019). It also seems that these images do not change much over time (Finson, 2002). The analysis of the studies, in which the DAST was used, show that scientists are doing science in laboratories (Medina-Jerez et al., 2011) and mostly related to chemistry (Türkmen, 2008), western male (Bang, Wong, & Jeffery, 2014), and dedicate their lives to humanity (Akcay, 2011). It was also found that children have views about science as a difficult or brainy discipline (Archer et al., 2012).

The source of such stereotypical images can be culture (Yacoubian, Al-Khatib, & Mardirossian, 2017), textbooks (Villar & Guppy, 2015), gender (She, 1998), age and socio-economic status (Baldu, 2006). Meyer and colleagues (2019) listed the other possible sources in their study as follows: individual, family, peer and school/educational contexts, but most prominently (popular) media (comics, television (TV) and movies in particular) (Avraamidou, 2013; Christidou, Hatzinikita, & Samaras, 2012; Koren & Bar, 2009; Mbajiorgu & Iloputaife, 2001; Medina-Jerez et al., 2011; Miele, 2014; She, 1998; Steinke et al., 2007; Tan, Jocz, & Zhai, 2015). Finson (2002) examined the studies about students' stereotypical images of scientists. He concluded that scientists in students' drawings were prevalently male and chemistry was the most common research field in the drawings.

Importance of the Study and Research Questions

The stereotypical images held by students can change concerning grade level (Ozel, 2012); prior science experiences (Milford & Tippett, 2013), nationality (Medina-Jerez et al., 2011), exposure to globalized popular

culture (Tan et al., 2017), and different socio-cultural contexts underlying science curricula and their implementation (Christidou, Bonoti, & Kontopoulou, 2016). Because of all these possible reasons or sources to have different stereotypical images of scientists, it is important to investigate students' perception of scientists. The other crucial reason for exploring children's perceptions related to scientists is to prevent their lack of interest in science and their avoidance of science careers. Individuals who have negative perceptions of science or scientists are not eager to choose a science-related career (Hammrich, 1997). Thus, an increased understanding of secondary students' images of scientists would enable science educators to develop science curricula that will change students' stereotypical images of scientists. Furthermore, exploring students' perceptions of scientists may provide valuable information in terms of curriculum development and instructional practices. Within this respect, the goal of the current study was to investigate the secondary students' perceptions of scientists through the DAST and to reveal whether these perceptions differed based on grade level and gender. The main research questions addressed by the current study were as follows:

- (1) How do middle school students describe an image of a scientist with respect to gender and grade level?
- (2) Which scientists are involved in middle school science textbooks that currently used in Turkey?
- (3) What do middle school students think to become a scientist?

Method

Participants

The sample of the study was 98 middle school students from a public school. Table 1 shows the distributions of the students concerning grade level and gender. Students' socio-economic backgrounds were similar to each other.

Table 1. Participants' Distribution Concerning Grade Level and Gender

Grade Level	Number of students	%
5 th Grade	21	21.4
6 th Grade	21	21.4
7 th Grade	32	32.6
8 th Grade	24	24.4
Female	51	52
Male	47	48
Total	98	100

Data Gathering Tools

DAST (Draw-A-Scientist Test)

The DAST developed by Chambers (1983) was used in the current study. Students were provided with a blank sheet of paper and asked to draw a scientist by using a pencil or crayons. The implementation process lasted for

a one-course hour.

Science Textbooks

The scientists involved in the middle school science textbooks (5th, 6th, 7th, and 8th grades) were examined in order to reveal whether there is a match between students' drawings and scientists' images in the textbooks. Two main criteria were determined to choose the textbooks: they must be approved by the Ministry of National Education and must be widely used. Totally four science textbooks were determined (one textbook from each grade) and examined.

Open-Ended Questions

An open-ended questionnaire was used as another data collection tool. The tool aims to interpret the data gathered from the DAST better. The open-ended questionnaire involved questions about the scientist's gender, age, and students' desires and reasons to become or not to become a scientist.

Data Analysis

The data gathered from the DAST was analyzed with respect to the checklist, in which the categories were adapted from the studies done by Chambers (1983), Finson, Beaver and Cramond (1995), and Özsoy and Ahi (2014). The categories included in the checklist were as follow: the scientist's gender, facial expression, physical appearances, clothes and accessories, how they work, working environment, symbols of research, inventions, and famous scientists. The drawings were analyzed with respect to the categories. Later, the drawings were examined concerning the grade level and gender of the students. The descriptive data presented via tables. Example figures were provided for each category. Students' drawings were coded as 5M (fifth grade-male student), 7F (seventh grade-female student) or 8M (eighth grade-male student).

For the images of scientists in the science textbooks, they were categorized with respect to grade level and the units. Finally, for the data gathered from the open-ended questionnaire, content analysis was used. The codes and categories were created by taking into account the answers given by the students. During the analysis, the words that students emphasized most in their answers were selected and the coding was made by taking these selected expressions into account. The frequency and percentage values for these data are presented in the tables. Students' answers include more than one code; therefore, the total frequency of the codes is more than the number of students.

Findings

Firstly, the data gathered from the science textbooks were presented. Then, the results of the DAST were given with respect to the categories. After that, the results based on the open-ended questionnaire were given.

Findings Based on the Science Textbooks

There were a total of 40 different scientists and 46 images of them in the four science textbooks. Whereas there were just four images of scientists in the sixth grade science textbook, there were 19 images of scientists in the seventh grade science textbooks. The topics related to the solar system and the nature of matter were two units, in which the images of scientists were used mostly. There were just two woman scientists (Madam Curie and Rachel L. Carson) mentioned in the science textbooks. Table 2 shows the categories of the scientists concerning the grade level and units.

Table 2. Distribution of the Images of Scientists in the Science Textbooks

	5 th grade	6 th grade	7 th grade	8 th grade
			- Galileo,	
	- Madam Curie		- Hans Lippershey	
	- Galileo		- Edwin Hubble	
1 st unit (related to the solar system)	- Yuri Gagarin	N/A	- Isaac Newton	N/A
	- Neil Armstrong		- Ali Kuşcu	
	- Ali Kuşcu		- Uluğ Bey,	
			- Aziz Sancar	
			- Zacharias Janssen	
2 nd unit (related to human biology)	- Aristoteles	N/A	- Antony van Leuwenhoek	- Gregor Mendel
	- Carl Linnaeus		- Robert Hooke	- Ian Wilmut
			- Theodar Schwann	- Lois Pasteur
	- Isaac Newton			
3 rd unit (related to force and motion)	- Hezarfen Ahmed Çelebi	N/A	N/A	- Evangelista Torricelli
				- Blaise Pascal
			- Democritus	- Dmitriy I. Mendeleev
			- John Dalton	- Johann W. Döbereiner
4 th unit (related to nature of matter)	N/A	N/A	- Joseph J. Thomson	- Henry Moseley
			- Ernest Rutherford	- Glenn Seaborg
			- Niels H. Bohr	- Søren P. L. Sørensen
5 th unit (related to light and sound)	- İbn-i Heysem	N/A	- Isaac Newton	N/A
6 th unit (related to environment and energy transformation)	- Rachel L. Carson	N/A	N/A	N/A
		- Benjamin Franklin		
7 th unit (related to electricity)	- Thomas Edison	- George Ohm	- Georg Ohm	N/A
	- Nikola Tesla	- Thomas Edison	- Thomas Edison	
		- Humphry Davy		
Total number of images of the scientists	13	4	19	10

The images of Thomas Edison and Isaac Newton were presented more than the other scientists in the science textbooks. Physics (10 scientists) and chemistry (10 scientists) related scientists were two major groups depicted in the textbooks. Besides, there were images of scientists whose research interest is biology (8 scientists), astronomy (6 scientists), philosophy (3 scientists), mathematics (2 scientists), and medicine (1 scientist).

Findings Based on the DAST

Gender

The findings revealed that many middle school students (72.4%) drew scientists as males. Almost all of the male students participating in the study (97.8%) drew male scientists, while only one male student drew a female scientist. Whereas half of the female students in the study drew male scientists, the other half of the female students drew female scientists. Table 3 shows the findings of the gender of the scientists in the drawings concerning grade level and gender.

Table 3. Gender of the Scientists in the Drawings Concerning Grade Level and Gender

	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Female Scientist	7	33.3	8	38.1	4	12.5	8	33.3	26	50.9	1	2.2	27	27.6
Male Scientist	14	66.6	13	61.9	28	87.5	16	66.6	25	49.1	46	97.8	71	72.4

Whereas Figure 1 shows drawings related to female scientists, Figure 2 indicates drawings of male scientists.



Figure 1. Drawings related to Female Scientists



Figure 2. Drawings related to Male Scientists

The drawings showed that female students drew more colorful drawings than male students. They mostly drew stereotypical drawings of scientists.

Facial Expression

Half of the students drew scientists as happy people. Twenty-eight of them thought scientists as thoughtful or confused. Table 4 shows the findings of the facial expressions of the scientists in the drawings concerning grade level and gender. As the grade level increased, students drew scientists more thoughtful, confused, and angry. Figure 3 shows some facial expressions of scientists drawn by middle school students.

Table 4. Facial Expressions of the Scientists in the Drawings Concerning Grade Level and Gender

	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Happy	13	61.9	16	76.2	13	40.6	8	33.3	26	50.9	24	51.1	50	51.0
Unhappy	2	9.5	1	4.7	2	6.25	3	12.5	5	9.8	3	6.4	8	8.4
Thoughtful	3	14.3	-	-	4	12.5	6	25.0	9	17.7	4	8.5	13	13.5
Angry	1	4.7	-	-	3	9.3	2	8.3	1	1.9	5	10.6	6	6.3
Confused	2	9.5	2	9.5	10	31.25	2	8.3	6	11.8	9	19.2	15	15.5
Expressionless	-	-	2	9.5	-	-	3	12.5	4	7.8	2	4.2	5	5.3



6M-Happy



7M-Angry



5M-Confused



8F-Expressionless

Figure 3. Drawings related to Facial Expressions

Physical Appearances

Students mainly (77.5%) drew scientists as young people. One-third of the middle school students drew them with glasses. Besides, 27.5% of students drew scattered hair scientists, while 20.4% drew a bearded scientist. Table 5 shows the findings of the physical appearances of the scientists in the drawings concerning grade level and gender. Figure 4 shows some physical appearances of scientists drawn by middle school students.

Table 5. Physical Appearances of the Scientists in the Drawings Concerning Grade Level and Gender

	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Young	14	66.6	20	95.2	24	75.0	18	75.0	40	78.4	36	76.6	76	77.5
Elderly	7	33.3	1	4.8	8	25.0	6	25.0	11	21.6	11	23.4	22	22.4
with Glasses	1	4.8	5	23.8	15	46.8	7	29.2	15	29.4	14	29.8	29	29.6
Messy hair	-	-	8	38.1	15	46.8	4	16.6	13	25.5	14	29.8	27	27.5
Bald	1	4.8	-	-	1	3.1	-	-	2	3.9	-	-	2	2.0
Long hair man	3	14.2	-	-	4	12.4	2	8.3	2	3.9	7	14.9	9	9.2
Whiskered	-	-	4	19.0	9	27.9	7	29.2	9	17.6	11	23.4	20	20.4
With a beard	-	-	4	19.0	3	9.3	3	12.5	2	3.9	8	17.0	11	11.2



6F



7M



8F

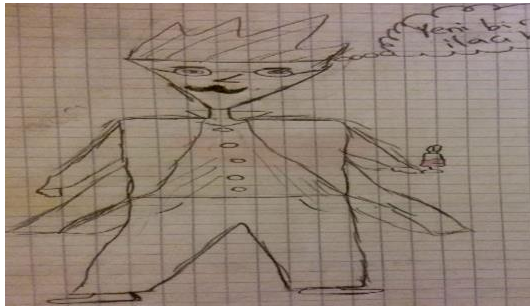
Figure 4. Drawings related to Physical Appearances

Clothes and Accessories

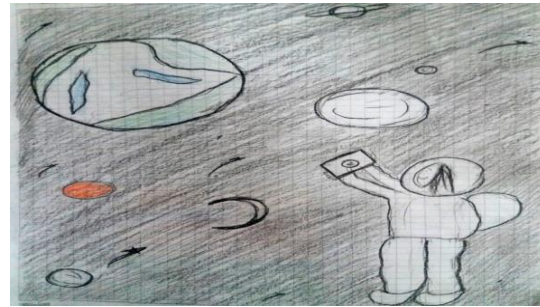
Almost half of the sixth and seventh-grade students drew scientists with a lab coat. One female student from seventh grade drew an astronaut as a scientist. Table 6 shows the findings of clothes and accessories of the scientists in the drawings concerning grade level and gender. Figure 5 shows some clothes and accessories of scientists drawn by the middle school students.

Table 6. Clothes and Accessories of the Scientists in the Drawings Concerning Grade Level and Gender

	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Lab coat	2	9.5	10	47.6	14	43.7	5	20.8	16	31.4	15	31.9	31	31.6
Tie	-	-	-	-	3	9.4	1	4.2	3	5.9	1	2.1	4	4.0
Hat	-	-	2	9.5	-	-	-	-	1	1.9	1	2.1	2	2.0
Astronaut suit	-	-	-	-	1	3.1	-	-	1	1.9	-	-	1	1.0



7M



7F



8M



5F

Figure 5. Drawings related to Clothes and Accessories of Scientists

How Scientists Work

Almost all of the students drew scientists as individuals. They mostly think that scientists work alone. Table 7 shows the findings of how scientists work in the drawings concerning grade level and gender. Figure 6 shows some examples of drawings about how scientists work.

Table 7. How Scientists Work in the Drawings Concerning Grade Level and Gender

	5 th Grade		6 th Grade		7 th Grade		8 th Grade		Female		Male		Total	
	(n=21)		(n=21)		(n=32)		(n=24)		(n=51)		(n=47)		(n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Individual	20	95.2	20	95.2	32	100	24	100	49	96.0	47	100	96	97.9
Group	1	4.8	1	4.8	-	-	-	-	2	4.0	-	-	2	2.1



Figure 6. Drawings related to How Scientists Work

Working Environment

Almost half of the fifth-grade students drew scientists in a lab environment. The number of students who drew scientists in an office was higher than the ones who drew them in space, garden or forest. Table 8 shows the findings of working environments of scientists in the drawings concerning grade level and gender.

Table 8. Working Environments of the Scientists in the Drawings Concerning Grade Level and Gender

	5 th Grade		6 th Grade		7 th Grade		8 th Grade		Female		Male		Total	
	(n=21)		(n=21)		(n=32)		(n=24)		(n=51)		(n=47)		(n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Laboratory	10	47.6	3	14.3	5	15.6	5	20.8	11	21.6	12	26.5	23	23.7
Office	3	14.3	2	9.5	2	6.2	2	8.3	5	9.8	4	8.8	9	9.4
Space	2	9.5	-	-	3	9.4	1	4.2	4	7.8	2	4.5	6	6.3
Garden/Forest	4	19.0	-	-	1	3.1	-	-	1	1.9	4	8.8	5	5.3
No place	2	9.5	16	76.2	21	65.6	16	66.6	30	58.8	24	51.2	54	55.3

Figure 7 shows some example drawings about the working environments of scientists drawn by middle school students.



8M



7M

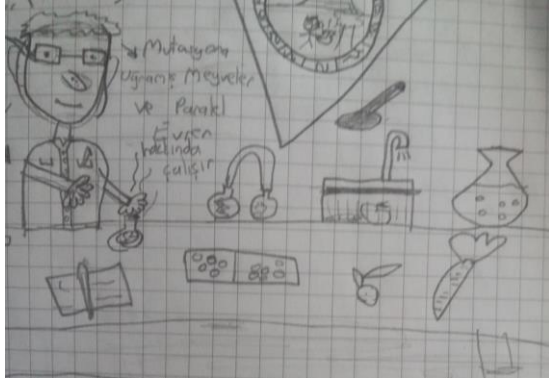
Figure 7. Drawings related to Working Environments of Scientists

Symbols of Research

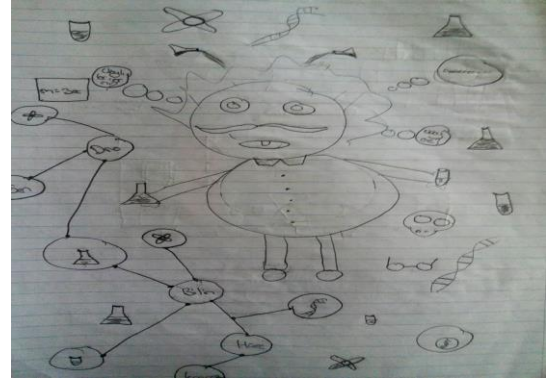
The findings show that there was usually laboratory equipment in the drawings especially in the ones drawn by the seventh-grade students. Table 9 shows the findings of symbols of research in the drawings concerning grade level and gender. Figure 8 shows some example drawings about symbols of research drawn by middle school students.

Table 9. Symbols of Research in the Drawings Concerning Grade Level and Gender

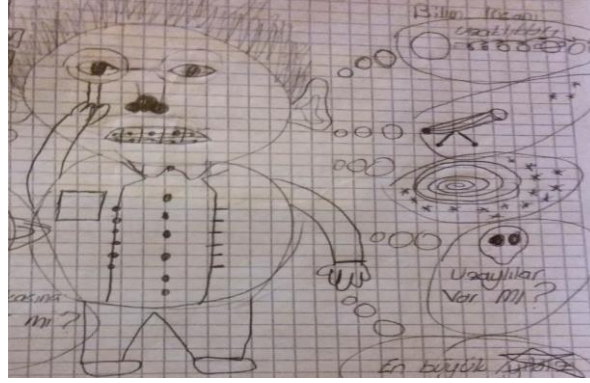
	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Table	6	28.6	1	4.8	7	21.9	5	20.8	8	15.7	11	23.4	19	19.4
Pencil	-	-	1	4.8	-	-	-	-	1	1.9	-	-	1	1.0
Cabinet	-	-	-	-	2	6.3	2	8.3	1	1.9	3	6.4	4	4.0
Textbook	-	-	2	9.6	5	15.6	1	4.2	5	9.8	3	6.4	8	8.2
Notice board	-	-	-	-	1	3.1	1	4.2	1	1.9	1	2.1	2	2.0
Banners and models	-	-	-	-	10	31.2	-	-	8	15.7	2	4.2	10	10.2
Telescope	1	4.8	-	-	1	3.1	1	4.2	-	-	3	6.3	3	3.0
Experimental Equipment	6	28.6	1	4.8	14	43.8	5	20.8	13	25.5	12	25.5	25	25.5
Time Machine	1	4.8	-	-	-	-	-	-	-	-	1	2.1	1	1.0



7M



7F



7F

Figure 8. Drawings related to Symbols of Research

Inventions

The seventh-grade students and male students drew more inventions in their drawings. Table 10 shows the findings of inventions in the drawings concerning grade level and gender. Drawings about space (25%) and intelligent robots (10%) are two common inventions drawn by middle school students.

Table 10. Inventions in the Drawings Concerning Grade Level and Gender

	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Bulb	4	19.0	-	-	2	6.2	-	-	2	3.9	4	8.5	6	6.1
Cloning	-	-	-	-	-	-	2	8.3	-	-	2	4.3	2	2.0
Drug	2	9.5	-	-	1	3.1	1	4.2	1	1.9	3	6.4	4	4.1
Living things	2	9.5	-	-	-	-	-	-	2	3.9	-	-	2	2.0
Invisibility Potion	-	-	1	4.8	1	3.1	-	-	1	1.9	1	2.1	2	2.0
Intelligent robots	2	9.5	4	19.0	1	3.1	3	12.6	4	7.8	6	12.8	10	10.2
Diseases	-	-	-	-	1	3.1	-	-	1	1.9	-	-	1	1.0
Space	4	19.0	3	14.3	14	43.8	4	16.8	9	17.6	16	33.6	25	25.5
Dinosaur	1	4.8	-	-	-	-	-	-	-	-	1	2.1	1	1.0
Mathematics/Geometry /Physics/Chemistry	1	4.8	-	-	1	3.1	5	20.8	5	9.8	2	4.3	7	7.1
Gene map	-	-	-	-	2	6.2	-	-	2	3.9	-	-	2	2.0
Vehicle for disabled	-	-	-	-	-	-	2	8.3	2	3.9	-	-	2	2.0
Alchemical	-	-	-	-	-	-	3	12.6	1	1.9	2	4.3	3	3.1

Famous Scientists

Albert Einstein, Isaac Newton, Thomas Edison, and Aziz Sancar were famous scientists drawn by the students. Table 11 shows the findings of famous scientists in the drawings concerning grade level and gender. Whereas the fifth-grade students usually drew Newton, female students preferred to draw Einstein in their drawings. Figure 9 shows some examples of drawings about famous scientists drawn by middle school students.

Table 12. Students' Response to Become a Scientist for Their Future Career

	5 th Grade (n=21)		6 th Grade (n=21)		7 th Grade (n=32)		8 th Grade (n=24)		Female (n=51)		Male (n=47)		Total (n=98)	
	f	%	f	%	f	%	f	%	f	%	f	%	f	%
Yes, I want	16	76.2	12	57.1	10	31.2	6	25.0	21	41.2	24	51.1	45	45.9
No, I don't	5	23.8	8	38.1	18	56.2	17	70.8	25	49.0	22	46.8	47	47.9
Not sure	-	-	1	4.8	4	12.6	1	4.2	5	9.8	1	2.1	6	6.2

The findings show that when the grade level increases, students' interests to become a scientist decrease. Almost half of the girls don't want to be a scientist for their future career. Furthermore, the number of students who don't want to prefer jobs related to science and technology was higher than the ones who would like to be a scientist.

The next question for the students, who answered the first question as Yes, was why you would like to be a scientist. Table 13 shows the students' reasons to become a scientist. There were three main reasons for students to become a scientist for their career: characteristics of science, individual accomplishments, and social benefits.

Table 13. Students' Reasons to Become a Scientist for Their Future Career

Themes	Categories	Number of Students
Social benefit (f: 15)	Contribution to humanity	11
	Making life easier	4
Product (f:5)	Inventing	5
Individual achievements (f:17)	Reputation	1
	Making history	3
	Respect	4
	Willingness to learn everything	9
Because of features of science (f:21)	Enjoyable	7
	Interesting	5
	Exciting	1
	Experiments	8
Having characteristics of a scientist (f:3)	Curious	2
	Patient	1

Similarly, the second question was asked to the students, who responded to the first question as No. The question was why you would not like to be a scientist. Table 14 shows students' reasons for not becoming a scientist. Students mainly think that they don't have specific characteristics to be a scientist. They also have negative opinions about scientific investigations and have different career plans.

Table 14. Students' Reasons for Not Becoming a Scientist in Their Future Career

Themes	Categories	Number of Students
Negative thoughts on scientific studies (f: 20)	Very difficult	9
	Very boring	8
	Necessary to work hard	2
	Unsocial	1
Individual characteristics (f: 27)	Not an investigative	2
	Not patient	15
	Not so smart	8
	Not curious	2
Different plans for the future (f: 19)	Not my interest	13
	Not in my dream	6

Discussion

In the current study, the images of scientists in the science textbooks, middle school students' drawings related to scientists, and views about becoming a scientist for their future careers were examined. The findings revealed that the majority of the students drew scientists as males. Even half of the female students drew scientists as male. The result is consistent with other studies (Emvalotis & Koutsianou, 2018; Thomson, Zakaria, & Radut-Taciu, 2019). Furthermore, the finding shows that although many years have passed, there is no dramatic change in students' perceptions of the gender of scientists (Barman, 1997; Chambers, 1983; Ford & Varney, 1989). Furthermore, the images of scientists were mostly men in the science textbooks; this might have an impact on students' perceptions about scientists.

Half of the students drew scientists as happy individuals. Similarly, some other studies concluded that middle school students usually think of scientists as happy people (Ozel, 2012). It was also reached that although almost all of the sixth-grade students drew scientists as happy, the number of students decreased as the grade level increased. It was also reached that most of the students drew scientists as young people. This finding was different from some other studies (Akçay, 2011; Meyer et al., 2019) and also contradicted the images of scientists in the textbooks, which were mostly elderly people.

Students mainly drew scientists with lab coats and eyeglasses. This is also a common result in the literature (Camcı-Erdoğan, 2013; Rodari, 2007). The images reflected in these drawings depict the scientists who constantly work in the laboratory and do an experiment. The drawings also show that students still have

stereotypical images and perceptions about scientists, the nature of science, and science. Students should be taught about science activities that are not limited to the ones in the laboratory (Toğrol, 2013). Besides, the scientists presented in the textbooks were mostly from natural sciences such as physics, chemistry, and biology. This may affect students' perception that scientists have to work in laboratories. In this context, science education programs and textbooks might need to be revised.

Almost all of the students drew scientists who work individually. This finding is consistent with the ones done by Cakmakci et al. (2011) and Ruiz-Mallén and Escales (2012). It is also a result that is compatible with the images of scientists in the textbooks, which were mostly depicted alone. It should be emphasized that scientific investigations usually are not done as an individual; it is also common to do scientific experiments as a group (Toğrol, 2013).

The proportion of students, who drew scientists indoors such as laboratories and offices/rooms, was higher than the students who drew scientists outdoor such as in gardens or space. Similarly, there are also many other studies in which students drew scientists indoors (Akçay, 2011; Finson et al., 1995; Korkmaz & Secken, 2015). As mentioned before, the scientists in the textbooks are commonly represented indoors such as laboratories, so this can also have an impact on such a result. This image of scientists in students' minds can be differentiated by activities they can do outside of the classroom. Therefore, teachers can be suggested to organize out-of-school activities.

Laboratory equipment was the most common symbol of research in the students' drawings. It was reached that eighth grade students gave fewer details about the research symbols than the students in the other grades. Similarly, girls drew more research symbols than boys in their drawings. In the related literature, there are studies in which 10-12 years old students drew liquids or chemicals as research symbols (Rodari, 2007). It was also found that students in the current study used chemical equipment and symbols in their drawings as the other studies (e.g., Finson, 2003). This may be due to the fact that the scientist they encounter in textbooks, television or visual media uses these symbols more. Toğrol (2000) also emphasized that the media has a strong effect on the scientist-related images in students' minds. It was also reached that pens, cabinets, books, astronomical visuals, boards, notebooks, scientific models, and mathematical signs were also involved in the students' drawings. These are also consistent symbols found by the other studies (Barman, 1997; Christidou, 2011; Finson, 2003; Kara & Akarsu, 2013; Özsoy & Ahi, 2014).

Boys drew more inventions in their drawings than girls. Similarly, seventh-grade students' drawings involved more inventions than the students from the other grades. Space-related inventions and intelligent robotics were the two common inventions mentioned in the students' drawings. These drawings may reflect students' ideas for their professional careers. This arises from the argument that the stereotypical perceptions of scientists may affect students' interest in and attitudes towards science, and career preferences (Finson, 2002; Steinke et al., 2007).

The most famous scientists drawn by the students were Albert Einstein and Isaac Newton. In the related

literature, there are studies in which students' drawings mostly included Einstein and Edison (Korkmaz & Kavak, 2010; Özsoy & Ahi, 2014). This result might show that students imagine the scientists they met in their science textbooks or classes. Yet, in the current study, although there was no image of Einstein in the textbooks, students frequently drew him. This may be because the students encounter the image of Einstein in many other environments such as media or the internet. Korkmaz and Kavak (2010) investigated the reasons for students' preferences about famous scientists of the students. They concluded that students mainly address the scientists as "famous" due to their scientific studies.

The findings of the open-ended questionnaire revealed that more than half of the students were not eager or not sure to become a scientist. It was also reached that students' interest to be a scientist for their future career decreased concerning grade level. This could be due to an increase in the difficulty of the science course. In addition, as the grade level increases, students get familiar with the nature of science and the features of science, so students can decide whether their characteristics are suitable for being a scientist. In terms of gender, half of the boys and half of the girls were eager to be a scientist. Balkı, Çoban, and Aktaş (2003) concluded that students think that people, who read a lot of books, work continuously, smart, knowledgeable, and research, can be scientists. Similar thoughts were also revealed in this study.

Conclusion

The results of the current study show that middle school students generally have stereotypical scientist perceptions. The other crucial conclusion is that students' interest to become a scientist decrease when the grade level increases. It is important to attract their interests to science and to become a scientist. Teachers have vital roles in this process. For example, they can use various teaching methods in science classes to make science classes more enjoyable. They can present more examples that emphasize the relation between science and daily life, and help students understand science is a part of daily life and should not be afraid. Moreover, further studies are also needed to reveal the factors that have an impact on students' interest in science and how to deal with these.

References

- Akçay, B. (2011). Turkish elementary and secondary students' views about science and scientists. *Asia-Pacific Forum on Science Learning and Teaching*, 12(1), 1-11.
- Archer, L., DeWitt, J., Osborne, J., Dillon, J., Willis, B., & Wong, B. (2012). "Balancing acts": Elementary school girls' negotiations of femininity, achievement, and science. *Science Education*, 96(6), 967-989.
- Avraamidou, L. (2013). Superheroes and supervillains: Reconstructing the mad-scientist stereotype in school science. *Research in Science and Technological Education*, 31(1), 90-115.
- Balkı, N., Çoban, A. K., & Aktaş, M. (2003). İlköğretim öğrencilerinin bilim ve bilim insanına yönelik düşünceleri [Primary school students' thoughts about science and scientists]. *Uludağ University Journal of Faculty of Education*, 17(1), 11-17.
- Bang, E., Wong, S. S., & Jeffery, T. D. (2014). High school students' stereotypic images of scientists in South

- Korea. *International Journal of Education*, 4(1), 96-112.
- Barman, C. R. (1997). Students' views of scientists and science: Results from a national study. *Science and Children*, 35(1), 18-24.
- Britner, S. L. (2008). Motivation in high school science students: A comparison of gender differences in life, physical, and earth science classes. *Journal of Research in Science Teaching*, 45(8), 955-970.
- Buldu, M. (2006). Young children's perceptions of scientist: A preliminary study. *Educational Research*, 48(1), 121-132.
- Cakmakçı, G., Tosun, O., Turgut, S., Orenler, S., Sengul, K., & Top, G. (2011). Promoting an inclusive image of scientists among students: Towards research evidence-based practice. *International Journal of Science and Mathematics Education*, 9(3), 627-655.
- Camcı-Erdoğan, S. (2013). Gifted and talented students' images of scientists. *Turkish Journal of Giftedness and Education*, 3(1), 13-37.
- Chambers, D. W. (1983). Stereotypic images of the scientists: The draw-a-scientist test. *Science Education*, 67(2), 255-265.
- Chionas, G., & Emvalotis, A. (2021). How Peruvian secondary students view scientists and their works: Ready, set, and draw! *International Journal of Education in Mathematics, Science, and Technology (IJEMST)*, 9(1), 116-137.
- Christidou, V. (2011). Interest, attitudes and images related to science: Combining students' voices with the voices of school science, teachers, and popular science. *International Journal of Environmental and Science Education*, 6(2), 141-159.
- Christidou, V., Hatzinikita, V., & Samaras, G. (2012). The image of scientific researchers and their activity in Greek adolescents' drawings. *Public Understanding of Science*, 21(5), 626-647.
- Christidou, V., Bonoti, F., & Kontopoulou, A. (2016). American and Greek children's visual images of scientists. *Science Education*, 25(5-6), 497-522.
- El Takach, S., & Yacoubian, H.A. (2020). Science teachers' and their students' perceptions of science and scientists. *International Journal of Education in Mathematics, Science and Technology (IJEMST)*, 8(1), 65-75.
- El Takach, S., & Al Tobi, A. (2021). Teachers and students' perceptions of science and scientists: A comparative study. *International Journal on Social and Education Sciences (IJonSES)*, 3(1), 126-160.
- Emvalotis, A., & Koutsianou, A. (2018). Greek primary school students' images of scientists and their work: Has anything changed? *Research in Science and Technological Education*, 36(1), 69-85.
- Finson, K. D. (2002). Drawing a scientist: What we do and do not after fifty years of drawing. *School Science and Mathematics*, 102(7), 335-345.
- Finson, K. D. (2003). Applicability of the DAST-C to the images of scientists drawn by students of different racial groups. *Journal of Elementary Science Education*, 15(1), 15-26.
- Finson, K. D., Beaver, J. B., & Cramond, B. L. (1995). Development and field test of a checklist for the draw-a-scientist test. *School Science and Mathematics*, 95(4), 195-205.
- Ford, D. C., & Varney, H. L. (1989). How students see scientists: Mostly male, mostly white, and mostly benevolent. *Science and Children*, 26(8), 8-13.
- Hammrich, P. L. (1997). *Confronting the gender gap in science and mathematics: The sisters in science*


- program. (Report No. SE059829). Oak Brook, IL: National Association for Research in Science Teaching. (ERIC Document Reproduction Service No. ED 406167).
- Hatisaru, V., & Murphy, C. (2019). "Creature" teachers "monster" mathematicians: Students' views about mathematicians and their stated attitudes to mathematics. *International Journal of Education in Mathematics, Science and Technology (IJEMST)*, 7(3), 215-221.
- Kara, B., & Akarsu, B. (2013). Determining the attitudes towards and images of the scientists among middle school students. *Journal of European Education*, 3(1), 8-15.
- Koren, P., & Bar, V. (2009). Pupils' image of 'the scientist' among two communities in Israel: A comparative study. *International Journal of Science Education*, 31(18), 2485-2509.
- Korkmaz, H., & Kavak, G. (2010). Primary school students' images of science and scientists. *Elementary Education Online*, 9(3), 1055-1079.
- Korkmaz, H., & Secken, N. (2015). Images of chemical scientists through Turkish primary students' eyes: Implications for curriculum and instruction. *Procedia-Social and Behavioral Sciences*, 174, 1321-1329.
- Mbajjorgu, N. M., & Iloputaife, E. C. (2001). Combating stereotypes of the scientist among pre-service science teachers in Nigeria. *Research in Science and Technological Education*, 19(1), 55-67.
- Mead, M., & Metraux, R. (1957). Image of the scientists among high-school students. *Science*, 126(3270), 384-390.
- Medina-Jerez, W., Middleton, K. V., & Orihuela-Rabaza, W. (2011). Using the DAST-C to explore Colombian and Bolivian students' images of scientists. *International Journal of Science Education*, 9(3), 657-690.
- Meyer, C., Guenther, L., & Joubert, M. (2019). The draw-a-scientist in an African context: Comparing students' (stereotypical) images of scientists across university faculties. *Research in Science and Technological Education*, 37(1), 1-14.
- Miele, E. (2014). Using a draw-a-scientist test for inquiry and evaluation. *Journal of College Science Teaching*, 43(4), 36-40.
- Milford, T. M., & Tippett, C. D. (2013). Preservice teachers' images of scientists: Do prior science experiences make a difference? *Journal of Science Teacher Education*, 24(4), 745-762.
- Miller, D. I., Nolla, K. M., Eagly, A. H., & Uttal, D. H. (2018). The development of children's gender-science stereotypes: A meta-analysis of 5 decades of U.S. draw-a-scientist studies. *Child Development*, 89(6), 1943-1955.
- Ozel, M. (2012). Children's images of scientists: Does grade level make a difference? *Educational Sciences: Theory and Practice*, 12(4), 3187-3198.
- Özsoy, S., & Ahi, B. (2014). Images of scientists through the eyes of the children. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education*, 8(1), 204-230.
- Rodari, P. (2007). Science and scientist in the drawings of European children. *Journal of Science Communication*, 6(3), 1-12.
- Ruiz-Mallén, I., & Escalas, M. T. (2012). Scientists seen by children: A case study in Catalonia, Spain. *Science Communication*, 34(4), 520-545.
- Sharma, R. A., & Honan, E. (2020). Fijian pre-service teachers' ideas about science and scientists. *Journal of Science Teacher Education*, 31(3), 335-357.
- She, H. C. (1998). Gender and grade level differences in Taiwan students' stereotypes of science and scientists.

Research in Science and Technological Education, 16(2), 125-135.

- Steinke, J., Lapinski, M. K., Crocker, N., Zietsman-Thomas, A., Williams, Y., Evergreen, S. H., & Kuchibhotla, S. (2007). Assessing media influences on middle school-aged children's perceptions of women in science using the draw-a-scientist test. *Science Communication*, 29(1), 35–64.
- Subramaniam, K., Harrell, P. E., & Wojnowski, D. (2013). Analyzing prospective teachers' images of scientists using positive, negative and stereotypical images of scientists. *Research in Science and Technological Education*, 31(1), 66-89.
- Tan, A. L., Jocz, J. A., & Zhai, J. (2017). Spiderman and science: How students' perceptions of scientists are shaped by popular media. *Public Understanding of Science*, 26(5), 520-530.
- Thomson, M. M., Zakaria, Z., & Radut-Taciu, R. (2019). Perceptions of scientists and stereotypes through the eyes of young school children. *Education Research International*, 2019, 1-13.
- Toğrol, A. Y. (2000). Student images of the scientists. *Education and Science*, 25(118), 49-56.
- Toğrol, A. Y. (2013). Turkish students' images of scientists. *Journal of Baltic Science Education*, 12(3), 289-298.
- Türkmen, H. (2008). Turkish primary' students perceptions about scientist and what factors affecting the image of scientists. *Eurasia Journal of Mathematics, Science and Technology Education*, 4(1), 55-61.
- Villar, P., & Guppy, N. (2015). Gendered science: Representational dynamics in British Columbia science textbooks. *Canadian Journal of Education*, 38(3), 1-24.
- Yacoubian, H. A., Al-Khatib, L., & Mardirossian, T. (2017). Analysis of the image of scientists portrayed in the Lebanese national science textbooks. *Science and Education*, 26(5), 513-528.

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