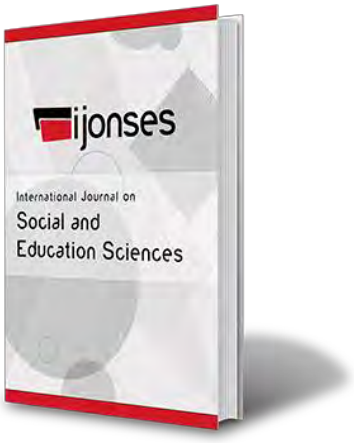

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Kevser Arslan
Yildiz Technical University, Turkey

Hakan Akcay
Bogazici University, Turkey

Hasan Ozgur Kapici
Bogazici University, Turkey

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Kevser Arslan, Hakan Akcay, Hasan Ozgur Kapici

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Abstract

This study aims to reveal whether there are any relations between secondary school students' perceptions of scientists and the images of scientists in secondary school science textbooks. The participants of the study were 140 secondary school students from a public school. The study is based on a qualitative research methodology. Qualitative research methods were used in the research. As a data collection tools, the Draw a Scientist Test (DAST) and secondary school science textbooks were used. The drawings obtained from the students and the images of scientists in the science textbooks were analyzed in the context of the determined themes. As a result of the study, it was determined that the students generally drew the scientist as male, thoughtful, wearing a lab coat and glasses, and young, with long and curly hair. It has been observed that scientists express their working environment as people who work alone in the laboratory and library environment. It also stands out that they benefit from computers and other technological apparatus like telescopes. It was determined that the students mostly included the drawings of Isaac Newton, Galileo Galilei, and Albert Einstein at each grade level as famous scientists. It has been determined that the drawings made by the students were influenced by the images from the textbooks.

Introduction

Science, which makes progress with the developing technology day by day, necessitates changes in current understandings. Increasing scientific knowledge day by day can become a discipline that can find its place in all areas of life and can have a significant impact on individuals. It is very important for students to understand and learn science, which has become a part of technology and is affected by cultures as a human activity (Akçay, 2011). Along with scientific knowledge that has gained importance and become valuable, it can be aimed to increase the number and quality of scientists responsible for the advancement of scientific knowledge. In this direction, young people's perceptions of science and scientists come to the fore at the point of encouraging them to work in the scientific field and have a career (Karaçam, Bilir & Danışman, 2021). By emphasizing the necessity of gaining high-level thinking skills, reasoning, and scientific literacy skills (Rahayu, 2017), it is necessary to equip students with 21st century skills to meet the need for scientific knowledge (Latifi et al., 2020, 2021; Noroozi, 2022; Noroozi et al., 2012, 2020; Ozturk, 2023; Valero Haro et al, 2019, 2022). Students' willingness and interest in science is to recognize the effects of science by providing accessibility to science and to accept opportunities

to develop scientific literacy (Medina-Jerez, Melville & Walker, 2015). Scientific knowledge can highlight responsible individuals in terms of making decisions based on science and participating effectively in changes.

Considering the fact that science takes a large part in daily life, it may be valuable to speculate on the scientific needs of individuals, their data sources and how they are interpreted (González García, Blanco-López, España-Ramos & Franco-Mariscal, 2021). Archer-Bradshaw (2017) points out the need for individuals to have knowledge about science and scientists as the first condition for fulfilling national goals in terms of nature and personal decisions. Individuals are expected to represent the knowledge and knowledge of scientists and their roles, perceptions and images in society (Fung, 2002; Medina-Jerez, Middleton & Orihuela-Rabaza, 2011). Considering the practices of scientists, it is sought to reinforce, expand and enrich their own statements with the perspectives of scientists, making them qualified or changing them (Hodson & Wong, 2014; Wong & Hodson, 2009).

Students' perceptions of science and their studies towards scientists can be affected by their experiences with science, how they perceive science, and their knowledge transmitted through the environment. It may be important to put students' science perceptions in the middle (Thomson, Zakaria & Radut-Taciu, 2019). Examining and encouraging the perceptions of scientists and scientists can be of great interest and importance due to its unique position in the sense that it can serve as a tool in the acquisition of positive opinions (Steinberg, Wyner, Borman & Salame, 2015). It is stated that images of scientists affect the tendency of students to pursue a career in science, as there is a relationship between students' attitudes towards science and self-confidence (Finson, 2002). Similarly Özdemir (2019), states that negative thoughts that individuals may have towards science and scientists can also play an active role in shaping their perspectives on science and scientific activities. He explains that if the shaped perspective of science is negative, students' school life and thus their success can be negatively affected. The motivations and attitudes of individuals to be scientists can seriously affect their perceptions of scientists, their attitudes, interests, and learning about science (Buldu, 2006; Camcı Erdoğan, 2013; Chionas & Emvalotis, 2021; El Takach & Al Tobi, 2021; El Takach & Yacoubian, 2020; Losh, Wilke & Pop, 2008; Nuhoğlu & Afacan, 2011; Yontar Toğrol, 2013). Students' perceptions of science and scientists can shape their attitudes towards science and guide them in drawing their future career plans (Doğan, 2015). Students' perceptions of science and scientists, in addition to being one of the indicators of individuals' perceptions of scientists, can make students valuable in society by providing them with scientific literacy skills (Hatisaru & Murphy, 2019; Meyer, Günther & Joubert, 2019).

The idea that the images of scientists that individuals may have can affect students' scientific stances has increased the tendency of researchers to determine scientist images (Bağ, 2013). The constant orientation towards displaying images of scientists may be associated with stereotyped perceptions of scientists and their work environments creating anxiety. One of these concerns is the limitation of science and career participation motivations, and the other is that evaluation and decision-making on important scientific issues may be adversely affected (Besley, 2015; Emvalotis & Koutsianou, 2018). Therefore, the need to reveal the students' perception of who the scientist is and the role he/she assumes shows itself (Korkmaz & Kavak, 2010). In recent years, the trend towards studies of science and scientists has been increasing, and this trend shows an orientation towards the perceptions of children (Finson, 2002). It can be stated that studies on students' perceptions of scientists were accepted by Mead

and Metraux in 1957, and it started to gain popularity with the development of the drawing test by Chambers (1983) to make sense of scientist images (Fralick, Kearn, Thompson & Lyons, 2009). Every day, many studies of science and scientists continue to be found in the literature.

Field studies on the perceptions of scientists, it can be concluded that the images created by the scientists in the students show a stereotyped quality. In general, it has been found in studies that he has many qualities such as a male scientist with a lab coat or glasses, a beard or mustache, long or short hair, old or middle-aged, working with equipment and glass materials, and conducting experiments (Akçay, 2011; Ahi & Özsoy, 2014; Bang, Wong, & Jeffery, 2014; Bozzato, Fabris & Longobardi, 2021; Christidou, Hatzinikita & Samaras,2012; Eagly & Uttal, 2018; Emvalotis & Koutsianou, 2018; Ferguson & Lezotte, 2020; Finson, 2002; İvgin, Akçay & Kapıcı, 2021; Kara &Akarsu, 2013; Laubach, Crofford & Marek, 2012; Meyer, Guenther & Joubert, 2019; Miller, Eagly & Linn, 2015; Türkmen, 2008). Considering the idea that the perceptions of scientists have not changed, it can be stated that it should be handled in different dimensions and seriously.

The perception of scientist, which has a place in individuals, can be revealed with different methods and methods, and one of the tools used in detecting perceptions is known as drawings. Drawings have been used by researchers in many fields for many years (Prino, Pasta, Gastaldi & Longobardi, 2019; Quaglia, Gastaldi, Prino, Pasta & Longobardi, 2013), it is suggested that children are a tool that they can have fun and interest in (Cappello, 2005). Drawings are a common technique used to reveal and evaluate students' perceptions of scientists (Emvalotis & Koutsianou, 2018; Milford & Tippett, 2013). The Draw the Scientist Test (DAST) can be defined as one of the tools that fall into the drawing category used to reveal the perceptions of scientists. DAST was developed in 1983 for Chambers students to draw the images of scientists and to be more understandable. It has been designed with the aim of obtaining data against the deficiencies and limitations that school-age children may encounter verbally or in writing. It is a drawing test that can be applied at different levels and can be integrated into other methods (Avraamidou, 2013; Buldu, 2006; Chambers, 1983). In the literature, DAST drawing tool has been used in many studies to determine the perceptions of scientists for students of all ages (Akçay, 2011; Ahi & Özsoy, 2014; Bilir, Türk & Tüzün, 2020; El Takach & Yacoubian, 2020; Emvalotis & Koutsianou, 2018; Ferguson & Lezotte, 2020; Leblebicioğlu, Çetin, Eroğlu Doğan, Metin Peten & Çapkınoğlu, 2021; McCann & Marek, 2016; Medina-Jerez & Middleton, 2022; Meyer, Guenther & Joubert, 2019; Özdemir, 2019).

Identifying secondary school students' perceptions of scientists can be the first step to destroy and reduce stereotypical images of scientists. It will be important to reveal the images of scientists in order to enable students to comprehend the nature of science more effectively, to enable students to make sense of the importance of science, and to enable students to gain scientific thinking skills. On the other hand, encouraging students to do science and doing science or developing their attitudes in a positive way highlights the need to describe their images of scientists. It can be foreseen that the negative image of scientist, which may have gained a place in students due to the teaching or environmental effect at the primary school level, will be eliminated with an intervention that can be made at the secondary school level. In addition, it can reveal the position of the scientist image in terms of being a guide to the scientist careers and career choices of secondary school students. With the determined scientist perceptions of the students, an important road map can be presented to the educators in order

to make the students draw an effective scientist image. On the other hand, examining the scientists in the textbooks and determining at what level and at what points the textbooks affect the perception of scientists of secondary school students can be expressed as another research output. The study will reveal important clues in terms of directing the potential of textbooks to affect the perception of scientists or organizing textbooks in a positive way. Therefore, a valuable data source can be created in terms of reshaping the textbooks, science curriculum and stereotyped science perception framework with a scientist perception study to be added to the literature.

In this context, the aim of the present study was shaped based on the need to reveal images of scientists at different grade levels (Ahi & Özsoy, 2014) and the expected contributions of the study. In the study, it is aimed to reveal and examine the perceptions of secondary school students towards scientists. It aims to determine whether the perceptions of scientists differ according to the secondary school grade level. In addition, it is aimed to reveal the images of scientists and scientists in the secondary school science textbooks used in the teaching process in our country. The research questions formed in line with the purpose of the study are given below:

1. What are secondary school students' perceptions of scientists?
2. Do secondary school students' perceptions of scientists change according to grade level?
3. How do the images of scientists in secondary school science textbooks affect students' perceptions of scientists?

Method

Study Pattern

The study was carried out in accordance with the qualitative research methodology. Qualitative research provides the researcher with the opportunity to be flexible, to shape the research process according to the collected data, and to maintain both the research design and the data analysis process with an inductive approach (Yıldırım & Şimşek, 2018). It follows a process of presenting perceptions or events in a realistic and holistic way (Frankel, Wallen & Hyun, 2012; Yıldırım & Şimşek, 2018).

Qualitative data, with its strong potential to reveal complex situations, provides rich and holistic content as well as providing first-hand and effective descriptions of the data (Miles & Huberman, 2016). It is understood that it is appropriate with the objectives of qualitative study on the grounds that it is aimed to examine the scientists in the science textbooks. Based on the literature studies on the drawing of the scientist, the research process followed in the current study is given in Figure 1 in general (Akçay, 2011; Ateş, Ateş & Aladağ, 2021; Emvalotis & Koutsianou, 2018; Reinisch, Krell, Hergert, Gogolin & Krüger, 2017).

When Figure 1 is examined, the steps of the research process followed in the current study are seen. In the context of the study, it was followed by determining the research topic and research questions, making the drawings for the students, analyzing the drawings in line with the determined themes, identifying and examining the scientists in the science textbooks used by the students, and interpreting the data obtained.

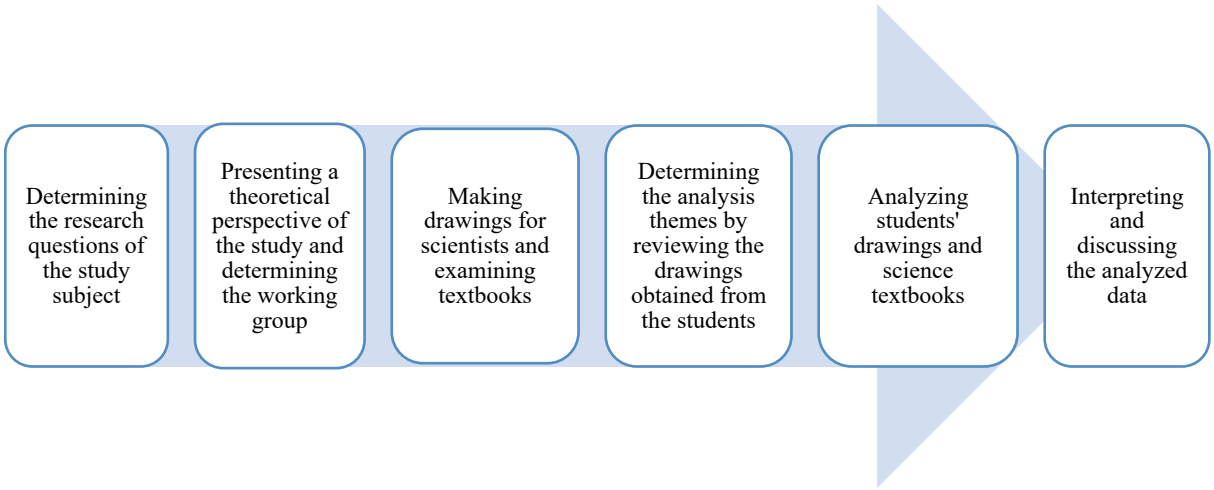

Figure 1. Research Process Followed in the Study

Study Group

The study group of the research consists of 140 secondary school students studying in a public school in the 2021-2022 academic years. In the created study group, it was taken into account that the students were from all levels of secondary school. Thus, it is aimed to reach a general judgment about the secondary school level and to reflect the secondary school level in terms of each grade level. The study was carried out with a total of 140 students selected at the 5th, 6th, 7th and 8th grade levels. In the selection of the study group, it was deemed appropriate to use easily accessible sampling, which is a type of purposive sampling, with the aim of gaining speed and practicality to the research (Yıldırım & Şimşek, 2018). The information about the grade level and gender of the secondary school students included in the study is given in Table 1.

Table 1. Information on the Grade Level and Gender of the Secondary School Students Included in the Study

Student Grade Level	Female Student	Male Student	Total
5th Grade	17	15	32
6th Grade	14	19	33
7th Grade	23	27	50
8th Grade	10	15	25
Total	64	76	140

When Table 1 is examined, information about the students included in the study can be seen. In the study, there are 32 students at the 5th grade, 33 at the 6th grade, 50 at the 7th grade, and 25 at the 8th grade. The study group consists of 64 female students and 76 male students.

Data Collecting Tools

In the study, the "Draw A Scientist Test" (DAST) test developed by Chambers (1983) was used in order to reveal the perceptions of secondary school students about scientists. DAST is a tool that provides the opportunity to

evaluate the perceptions of individuals despite their inability to give written answers, which is easier than most tests, but can create a series of interpretive difficulties, and allows them to express their thoughts about the scientist by drawing a picture (Chambers, 1983).

Ask the students, “What comes to your mind when you hear the word scientist?” question was posed. Using a blank paper, they were asked to draw a scientist with pencils and paints. The drawings were completed in about one lesson hour without giving any direction to the students. During the application, efforts were made not to affect the students' drawings of each other. The implementation process has been effectively completed.

Another tool that constitutes a data source in the study is the secondary school level science textbooks used by the students in the teaching process. In the selection of science textbooks determined to be examined within the framework of the study, the criteria of i) being approved by the Ministry of National Education ii) being used effectively in the teaching process) being used by the students participating in the study were taken as a basis. It is aimed to take into account the criterion of being used by the students who participated in the study, and to reveal whether the student drawings made and the scientists visuals in the examined textbooks show any harmony. A total of four science textbooks at the 5th, 6th, 7th and 8th grades, which are taught at each grade level of the secondary school, were examined.

Analysis of Data

The themes and categories determined in the analysis of the data obtained from the student drawings were evaluated on the basis of. Descriptive content analysis was used while analyzing the drawings of scientists. Descriptive analysis can be performed by considering the context of predetermined themes (Yıldırım & Şimşek, 2018). First of all, all student drawings were examined in the first stage. In the context of studies determined in the literature, the control of the obtained student drawings was provided for the scientist themes. The scribbled papers and non-drawing papers that could not provide data were excluded from the study.The drawing papers included in the scope of the study are numbered for ease of analysis. Numbering process; *S1-5(5th grade student 1st paper), S1-6(6th grade student 1st paper), S1-7(7th grade student 1st paper), S1-8(8th grade student 1st paper)* was carried out.

Evaluation themes were decided in line with the drawings in the obtained data sources and the studies carried out in the literature (Ahi & Özsoy, 2014; Akçay, 2010; Chambers, 1983; Christidou, Hatzinikita & Samaras, 2012; Emvalotis & Koutsianou, 2018; Finson, Beaver & Cramond, 1995; İvgin, Akçay & Kapıcı, 2021; Meyer, Günther & Joubert, 2018; Subramaniam, Harrell & Wojnowski, 2013). The analysis process was started as the decided themes would be "*Gender, Facial Expression, Physical Appearance, Clothing and Accessories, Working Styles, Working Environments, Research Symbols, Information Symbols, Famous Scientist, Technology Products*". In the next step, each paper was examined in depth based on the determined themes. Each data is placed under the appropriate theme and category. The placement evaluation process of each examined drawing was completed and analyzed. Frequency values for each of them were calculated, and when calculating frequency values, the case of having more than one answer for each student's drawing was taken into account. In order to support the findings

and tables presented in the study, examples of student drawings belonging to each grade level and themes are included. After the analysis, the findings were presented and the obtained data were interpreted.

Secondary school science textbooks were examined at all grade levels. The scientists included in the examined textbooks were determined. Scientists and scientists whose photos were included were examined. Textbooks were examined in general at the first stage. At the next stage, all scientists who were included in each unit in writing and visually were noted. After the re-examination, the page numbers of the images of scientists and scientists at each grade level were determined. The number and visuals of scientists were determined and evaluated in terms of gender and Turkish or foreign nationality. In the next stage, scientists were re-examined in terms of their physical characteristics, clothing and accessories. In the last stage, each grade level was tabulated on the basis of subject area and unit. In the findings section, tables and graphics were presented and frequency values were calculated. The visuals of the scientists were included in each class level, and the obtained data were interpreted. During the analysis of the data, two different researchers analyzed the data, and the coefficient of agreement between the evaluators was found to be 89, taking into account the codes they created.

Results

Please Within the scope of the study, the data obtained from student drawings and textbooks were analyzed and the findings of the analysis results are presented in this section.

Findings Obtained from Student Drawings

The findings of the student drawings examined within the framework of the study are included under this title. The findings of student drawings on the basis of grade level showing the distribution of scientists by gender are given in Table 2.

Table 2. Gender of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8thGrade	Total
Gender	Male Scientist	19	15	38	24	96
	Female Scientist	10	13	8	1	32
	Unspecified	3	5	4	-	12
	Total	32	33	50	25	140

*The unspecified theme was used to express stickman drawings or drawings in which gender was not clearly understood.

When Table 2 is examined, the findings of student drawings expressing the distribution of scientists by gender are seen. It is understood that secondary school students generally draw the scientist as male. It was revealed that 24 of the eighth-grade students who participated in the study were male and 1 of them was female scientists, 38 of the seventh grade students were male and 8 of them were female scientists. It was revealed that the sixth-grade students drew 15 male, 13 female, and the fifth-grade students drew 19 male and 10 female scientists. Examples

of student drawings of the genders of scientists are given in Figure 2.

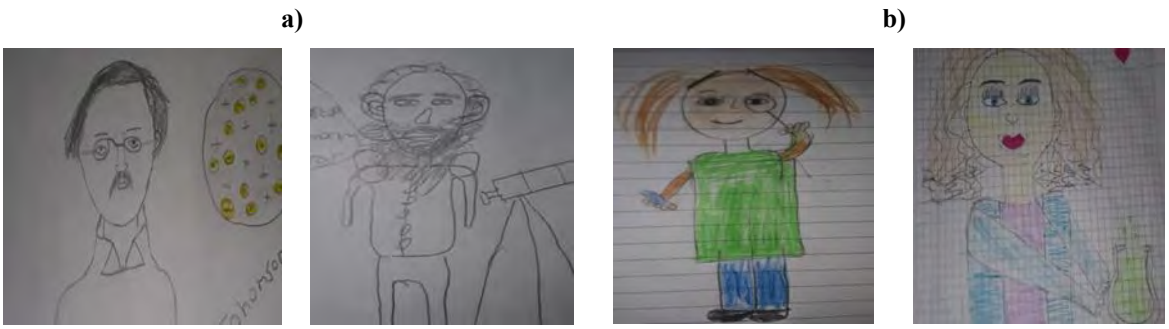

Figure 2. (a) Representation of Drawings about a Male Scientist (S27-7; S15-5), (b) Representation of Drawings about a Female Scientist (S21-8; S7-6)

The findings of student drawings on the basis of grade level showing the distribution of scientists according to their facial expressions are given in Table 3.

Table 3. Facial Expressions of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5th Grade	6th Grade	7th Grade	8thGrade	Total
	Thoughtful	8	13	18	6	45
	Happy	6	11	11	6	34
Facial	Confused	7	7	8	5	27
Expressions	Sad	3	1	5	3	12
	Nervous	2	1	2	3	8
	Insidious	-	-	1	-	1
	Bored	1	-	1	1	3
	Excited	2	-	1	-	3
	Total	29	33	47	24	133

*Drawings in which facial expressions are not clearly understood are not included.

When Table 3 is examined, the findings of student drawings expressing the distribution of scientists according to their facial expressions are seen. It is understood that secondary school students generally draw the facial expressions of the scientist as thoughtful and happy. It was revealed that 6 of the eighth-grade students who participated in the study drew a thoughtful and happy scientist, 18 of the seventh-grade students drew a thoughtful and 11 of them drew a happy scientists. It was revealed that 13 of the sixth-grade students drew a thoughtful scientist picture, 11 of them was a happy scientist, while 8 of the fifth-grade students drew a thoughtful scientist picture and 6 of them drew a happy scientist. It is understood that seventh grade students use scientist facial expressions differently in the insidious and bored categories.

In addition, it was determined that angry, excited, sad and confused facial expressions were drawn by secondary school students. Examples of student drawings of facial expressions of scientists are given in Figure 3.

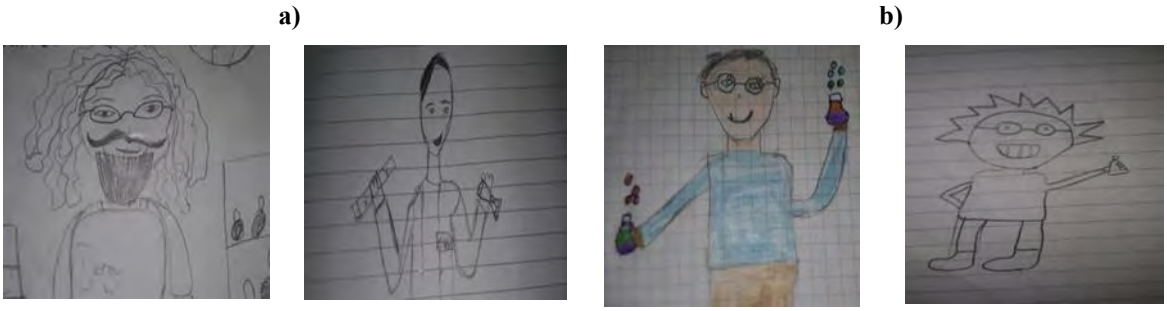

Figure 3. (a) Representation of the Drawing about the Scientist with a Thoughtful Facial Expression (S19-8; S13-7), (b) Representation of the Drawing about the Scientist with a Happy Facial Expression (S6-5; S5-8)

The findings of student drawings on the basis of grade level showing the distribution of scientists according to their physical appearance are given in Table 4.

Table 4. Physical Appearances of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8th Grade	Total
	Young	21	27	14	10	72
	Long Hair	14	12	17	14	57
	Straight Hair	16	14	14	8	52
	Old	9	6	11	15	41
Physical	Curly Hair	8	11	9	11	39
appearance	Short Hair	12	10	8	11	41
	Bearded	1	-	6	3	10
	With Moustache	4	1	6	7	18
	Spiky Hair	6	2	6	2	16
	Tongue Out	3	5	4	2	14
	Hair Loss	-	3	1	-	4
	Messy hair	9	10	2	1	22
	Total	103	101	99	84	386

When Table 4 is examined, the findings of student drawings expressing the distribution of scientists according to their physical appearances are seen. It is understood that secondary school students generally drew the scientist in a tall and straight young physical appearance. It was determined that the students who drew the scientist as old were at the eighth-grade level, and those who drew the scientist as young were more than the sixth-grade students. It was determined that it concentrated on the fifth-grade students who drew with the image of straight hair, and the sixth and eighth grade students who drew with the image of curly hair. While seventh grade students stand out in terms of showing scientists with long hair, sixth grade students stand out with short hair. While the fifth, seventh and eighth grade students were drawing beards, they did not use the beard image of the sixth-grade students. On the other hand, sixth and seventh grade students also included the quality of hair loss. In addition, it is understood that the images of the students with moustache, spiky hair, messy hair and tongue out were overlapped by scientists

and secondary school students. Examples of student drawings of the physical appearances of scientists are given in Figure 4.

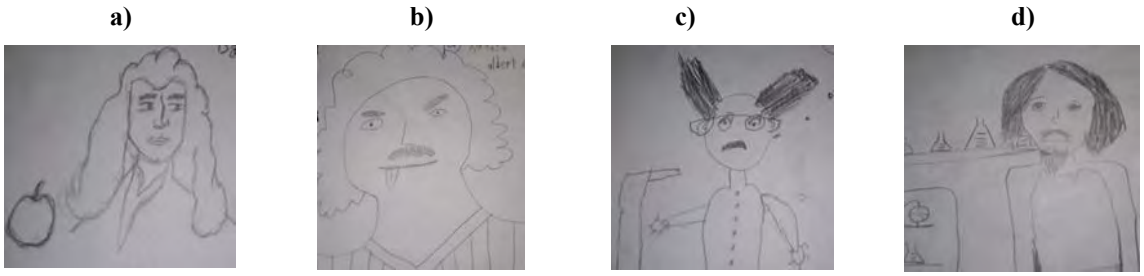

Figure 4. (a) Drawing Representation of a Young Scientist with Long Hair (S17-7), (b) Drawing Representation of an Old Scientist with his Tongue out (S3-5) (c) Drawing of a Spiky-haired Scientist Representation (S16-6), (d) Drawing Representation of a Scientist with a Long Hair and a Beard (S10-8)

The findings of student drawings on the basis of grade level showing the distribution of scientists according to their clothing and accessories are given in Table 5.

Table 5. Clothes and Accessories Owned by Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8th Grade	Total
Clothes and Accessories	Lab Coat	10	19	11	9	49
	Glasses	9	13	10	8	40
	Glove	6	3	5	2	16
	Boots	1	-	3	-	4
	Astronaut Suit	-	1	3	1	5
	Headphone	1	-	2	-	3
	Tie/Bowtie	2	2	2	1	7
	Hat	-	2	2	-	4
	Collar/Scarf	1	1	1	-	3
	Oversleeve	-	-	1	-	1
	Shirt	5	4	2	2	13
	Jacket	1	-	-	2	3
	Badge	-	1	-	-	1
	Belt	1	-	-	-	1
	Total	37	46	42	25	150

*In some drawings, only the head region is drawn, not the body of the scientists. Such drawings, where clothing and accessories are not specified, are not included in the table.

When Table 5 is examined, the findings of student drawings expressing the distribution of scientists according to their clothing and accessories are seen. It is understood that secondary school students generally drew the scientist with glasses and lab coats. It has been determined that the class level of the scientists who draw with a gown and

glasses is the sixth grade, and the grade level who draws with the astronaut outfit is the seventh grade. It was determined that the fifth graders were the most expressive of scientists with glove accessories. There were also students who associate scientists with accessories such as headphones, ties/bowties, hats, collars, arm cuffs, and badges. Examples of student drawings of clothing and accessories owned by scientists are given in Figure 5.

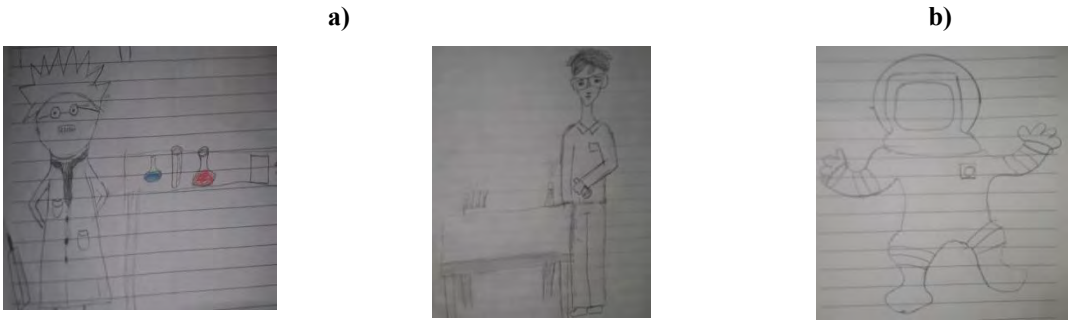

Figure 5. (a) Representation of the Drawing of the Scientist in a Lab Coat and Glasses (S5-6; S19-8), (b) Representation of the Drawing of the Scientist in an Astronaut Suit (S21-7)

The findings of student drawings on the basis of grade level showing the distribution of scientists according to their working styles are given in Table 6. When Table 6 is examined, the findings of student drawings expressing the distribution of scientists according to their working styles are seen. It is understood that secondary school students generally draw the working styles of scientists as individuals working alone. It was revealed that 24 of the eighth-grade students who participated in the study drew alone and 1 of them drew in a group, 42 of the seventh-grade students drew alone and 8 of them in groups. It was revealed that 31 of the sixth-grade students drew alone, 2 of them in a group, 29 of the fifth-grade students alone and 3 of them in a group of women. Student drawing examples of the working styles of scientists are given in Figure 6.

Table 6. Working Styles of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8th Grade	Total
Working Styles	Individual	29	31	42	24	126
	Group	3	2	8	1	14
	Total	32	33	50	25	140

Figure 6. (a) Representation of the Drawing about the Scientist Working alone (S6-5; S11-7), (b) Representation of the Drawing about the Scientist working in a Group (S18-5)

The findings of student drawings on the basis of grade level showing the distribution of scientists according to their working environments are given in Table 7.

Table 7. Working Environments of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8th Grade	Total
Working Environments	Laboratory	19	25	27	15	86
	Garden	2	5	6	2	15
	Library	8	1	-	-	9
	Space	1	1	4	2	8
	Theme Park	1	-	2	-	3
	Human Body	1	-	1	-	2
	Air	1	-	1	-	2
	Water	2	-	-	-	2
	Total	35	32	41	19	127

When Table 7 is examined, the findings of student drawings expressing the distribution of scientists according to their working environments are seen. It is understood that secondary school students generally draw the working environments of scientists as laboratories, gardens and libraries. The seventh-grade students mostly stated that they work in a laboratory environment. Following this, it was stated by the seventh and fifth graders that they worked in the garden environment. Associating the working environments of scientists as libraries was made mostly through fifth grade students. In addition, it is understood from the drawings of seventh grade students that the space environment creates a working environment for scientists. In addition to all these, student drawings stating that they work in amusement park, human body, air and water environment were also found. Examples of student drawings of scientists' working environments are given in Figure 7.

a) **b)** **c)**

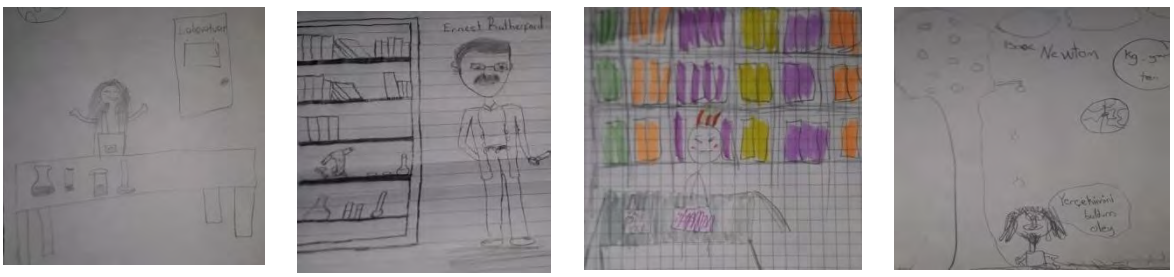

Figure 7. (a) Representation of the Drawing about the Scientist working in the Laboratory Environment (T34-7), (b) Representation of the Drawing about the Scientist working in the Library Environment (S14-8;S30-5), (c) The Scientist working in the Garden Environment Drawing Representation about Human Being (S46-7)

The findings of student drawings on the basis of grade level showing their distribution according to research symbols for scientists are given in Table 8. When Table 8 is examined, the findings of student drawings expressing the distribution of scientists according to research symbols are seen. It is understood that secondary school

students draw tables, balloon jojes and chemicals as symbols of research belonging to scientists in general. It is understood that the secondary school student, who indicated the desk as the research symbol of scientists, was at most sixth grade and at least eighth grade. It was found that the balloon and chemicals were drawn the most by the sixth-grade students. It is understood that the ruler and magnifying glass are also expressed as research symbols, but the ruler was not drawn by the seventh-grade students and the magnifying glass was not drawn by the eighth-grade students. In addition, dynamometer, dropper, magnet, thermometer, equal-arm balance were found in student drawings as research symbols. Student drawing examples of scientists' research symbols are given in Figure 8.

Table 8. Research Symbols of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8thGrade	Total
Research Symbols	Table	18	22	15	7	62
	Balloon Joje	5	12	6	3	26
	Cylinder Plate	1	10	8	4	23
	Chemicals	7	10	6	4	27
	Test Tubes	1	9	4	1	15
	Magnifying Glass	2	3	4	-	9
	Ruler	2	4	-	2	8
	Oven	-	3	1	-	4
	Dynamometer	-	-	2	-	2
	Equal arm scales	-	-	2	-	2
	Dropper	-	1	1	-	2
	Steam	-	1	1	-	2
	Magnet	-	1	1	-	2
	Tap	1	-	1	-	2
	Cooler	-	1	1	-	2
	Thermometer	-	2	-	-	2
	Total	37	79	53	21	190

a) **b)**

Figure 8. (a) Representation of the Drawing of the Research Symbol belonging to the Table and Materials (S27-7), (b) Representation of the Drawing of the Research Symbol of the Chemical Substances (S12-5)

The findings of student drawings on the basis of grade level showing their distribution according to information

symbols for scientists are given in Table 9.

Table 9. Knowledge Symbols of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5th Grade	6thGrade	7thGrade	8thGrade	Total
Knowledge Symbols	Sun, Earth and Moon	12	5	7	5	29
	Book/Notebook	9	6	3	3	21
	Formula	3	5	2	5	15
	Writing board	5	5	2	1	13
	Planets	5	3	2	1	11
	Stars	4	1	4	1	10
	Cabinet	4	3	1	1	9
	Note Papers	2	3	1	3	9
	Models	-	1	2	6	9
	Pencil	4	5	-	-	9
	Gravity (apple fall)	2	-	4	2	8
	Compound	-	2	2	4	8
	Numbers	4	2	-	-	6
	Letters	2	3	1	-	6
	Atomic Theories	-	-	5	1	6
	DNA Model	-	1	1	4	6
	Acids- Bases	1	2	-	3	6
	Living things	3	-	1	-	4
	Periodic table	-	-	-	3	3
	Layers	-	-	1	2	3
	Pea Cross	-	-	-	3	3
	Clone	-	-	-	2	2
	Weather Forecast	-	-	-	2	2
	Force/Motion	-	-	2	-	2
	Geometric Symbols	-	3	-	-	3
	Parachute	2	-	1	-	3
	Kilogram/Gram/Ton	-	-	1	-	1
	Pressure	-	-	-	1	1
	Sail	-	-	1	-	1
	Total	65	53	46	54	218

When Table 9 is examined, the findings of student drawings expressing the distribution of scientists according to information symbols are seen. It is understood that secondary school students mostly draw information symbols such as the sun, earth, stars, formula, book, notebook, and blackboard to the information symbols of scientists. It is seen that the gravity information symbol was not drawn by the sixth graders, the pencil symbol was not drawn

at the seventh and eighth levels, and the compounds were not drawn by the sixth graders. Numbers and letters and blackboard symbols are also included in student drawings. It is understood that the atomic theory information symbol was drawn by the seventh-grade students, while the periodic table and the DNA symbol were drawn by the eighth graders. In addition, information symbols such as layer, weather, geometric symbols, parachute, kilogram-gram, sail and pressure were found in student drawings. Student drawing examples of scientists' knowledge symbols are given in Figure 9.

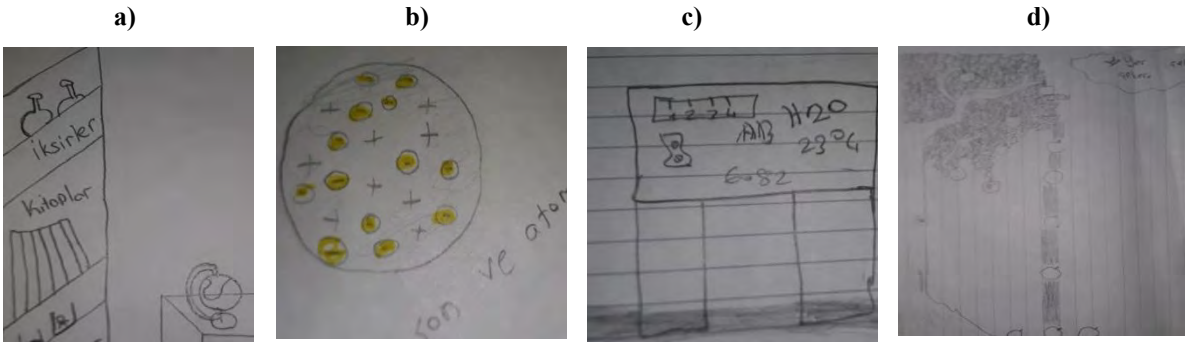

Figure 9. (a) Representation of the Drawing of a Book regarding the Information Symbol (S33-5), (b) Representation of the Drawing of the Information Symbol of the Atomic Model (S47-7). (b) Drawing Representation related to the Information Symbol belonging to Formulas, Numbers and Letters (S23-5), (d) Drawing Representation related to the Information Symbol belonging to Gravity (S41-7)

The findings of student drawings on the basis of grade level showing their distribution for famous scientists are given in Table 10.

Table 10. Famous Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8thGrade	Total
Famous Scientists	Isaac Newton	10	3	8	3	24
	Albert Einstein	8	7	5	3	23
	Aziz Sancar	4	1	1	4	10
	Ali Kuşçu	4	-	5	-	9
	Galileo Galilei	-	1	5	-	6
	Thomas Edison	5	-	1	-	6
	J.Wolfgang Döbereiner	-	-	-	4	4
	A. E. Beguyer de Chancourtois	-	-	-	3	3
	Gleen T. Seaborg	-	-	-	3	3
	Lothar Meyer	-	-	-	3	3
	James Chadwick	-	-	2	-	2
	J. J. Thomson	-	-	2	-	2
	Marie Curie	-	-	2	-	2
	NeilsBohr	-	-	1	-	1

Theme	Category	Frequency				
	Dimitri Mendelyev	-	-	-	1	1
	Nikola Tesla	-	-	-	1	1
	John Newlands	-	-	-	1	1
	Henry Moseley	-	-	-	2	2
	George Mendel	-	-	-	2	2
	Total	31	12	32	30	105

When Table 10 is examined, the findings of student drawings expressing the distribution of famous scientists are seen. It is understood that secondary school students generally draw famous scientists Isaac Newton, Albert Einstein, Aziz Sancar. It is reached that both foreign and Turkish scientists are drawn by the students. It was determined that the famous scientists drawn by the students were male scientists and only the Marie Curie scientist was drawn as a woman. It was drawn by the fifth and seventh grade students of Ali Kuşçu scientist, and by the sixth and seventh grade students of Galileo Galilei scientist. It was determined that the Thomas Edison scientist was drawn through the fifth grade, J. J. Thomson, Neils Bohr and James Chadwick scientists were drawn only through the seventh grades, and Henry Moseley, George Mendel, Dimitri Mendelyev scientists were drawn through the eighth grades. Examples of student drawings of famous scientists are given in Figure 10.

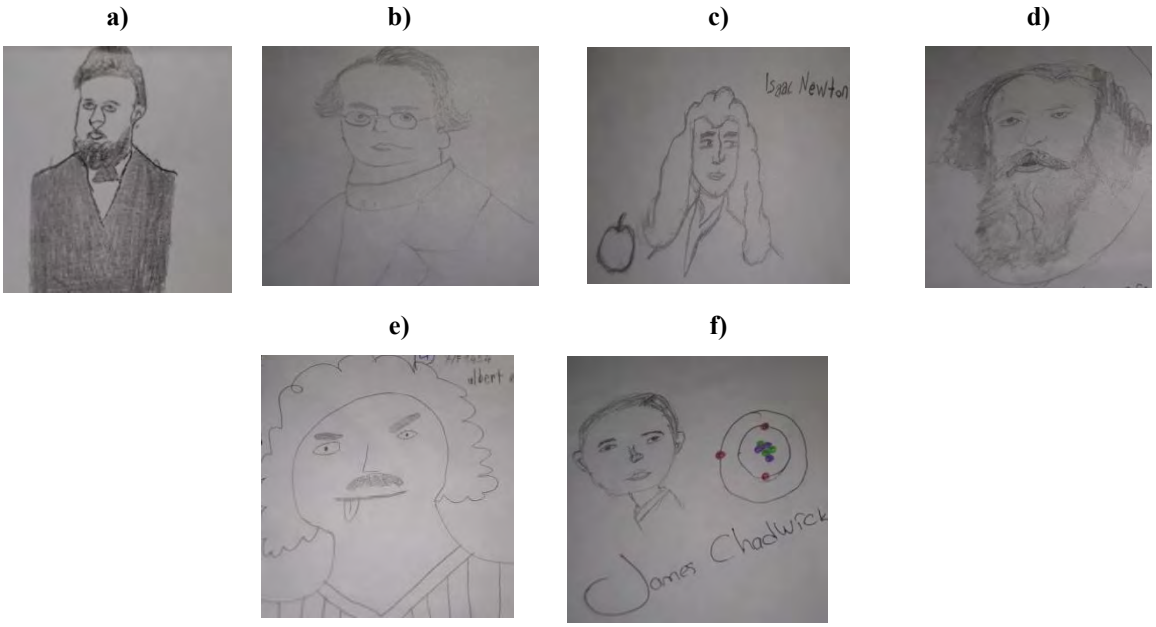

Figure 10. (a) Lothar Meyer Drawing Representation about Famous Scientist (S3-8), (b) George Mendel Drawing Representation about Famous Scientist (S7-8), (c) Isaac Newton Drawing Representation about Famous Scientist (S17-7). (d) Dimitri Mendeleev Drawing Representation about Famous Scientist (P20-8), (e) Albert Einstein Drawing Representation about Famous Scientist's Family (S3-5), (f) James Chadwick Drawing Representation about Famous Scientist (T13- 7).

The findings of student drawings on the basis of grade level showing their distribution according to technology-inventions for scientists are given in Table 11. When Table 11 is examined, the findings of student drawings

expressing the distribution of scientists according to technology products or inventions are seen. It is understood that secondary school students generally draw technology-invention symbols such as microscope, machine, spacecraft, computer, telescope, robot, vaccine. It has been revealed that the microscope, telescope and space vehicles are mostly drawn by the seventh graders, the time machine by the sixth graders and the computer by the fifth grades. It was determined that the seventh-grade drawings did not include satellite, vacuum, loudspeaker, electrical technologies, the fifth-grade drawings did not include internet connection, camera, oven, speaker, electrical technologies, and the sixth and eighth grade drawings did not include satellite, vacuum and electrical drawings. Student drawing examples of scientists' technology and invention products are given in Figure 11.

Table 11. Tech Products and Inventions of Scientists in Drawings by Grade Level

Theme	Category	Frequency				
		5thGrade	6th Grade	7th Grade	8thGrade	Total
Tech Products and Inventions	Microscope	2	4	7	5	18
	Spacecraft	1	5	7	3	16
	Machine (Time)	2	7	4	1	14
	Computer	6	5	2	1	14
	Telescope	3	3	5	1	12
	Robot	2	5	2	1	10
	Vaccine	1	3	2	1	7
	Internet connection	-	1	2	1	4
	Camera	-	2	1	1	4
	Oven	-	1	1	1	3
	Satellite	-	-	2	-	2
	Vacuuming	1	-	1	-	2
	Speaker	-	-	1	-	1
	Electric	-	-	1	-	1
	Total	18	36	38	16	113

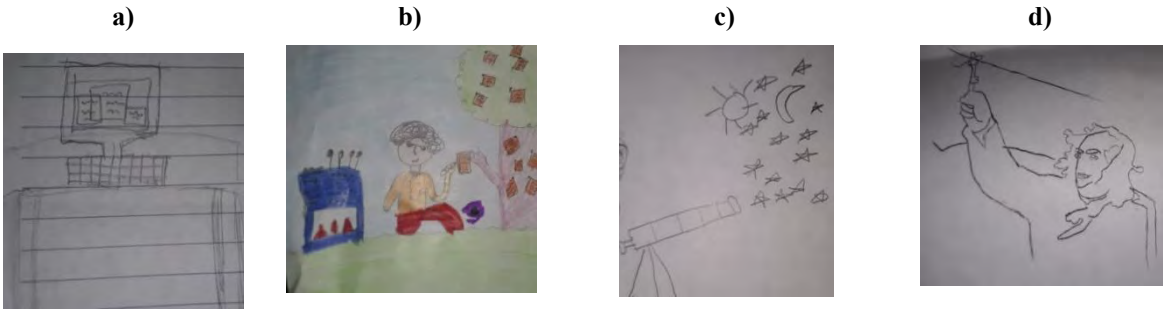

Figure 11. (a) Drawing Representation related to Computer Technology-invention Product (S21-6), (b) Drawing Representation related to Time Machine Technology-invention Product (S77-5). (c) Representation of the Drawing related to the Telescope Technology-invention Product (S15-5), (d) Representation of the Drawing regarding the Information Symbol related to the Drawing Representation related to the Electrical Technology-invention Product (S33-7)

Findings Obtained from Textbooks

Within the framework of the study, scientists and their images in the science textbooks at every grade level at secondary school were examined and the findings were included under this title. Table 12 shows the findings of scientists with and without pictures in the science textbooks examined on the basis of grade level.

Table 12. Scientists Included in Science Textbooks on the Basis of Grade Level

Grade	Scientists in the 5th Grade Textbook	Scientists in the 6th Grade Textbook	Scientists in the 7th Grade Textbook	Scientists in the 8th Grade Textbook
Scientists	*Ali Kuşçu *Arthur Schawlow *Charles Townes *Clarence Birdseye *Clerk Maxwell *Emile Levassor *Georges Claude *Gottlieb Daimler *Isaac Newton *Joseph Swan *Karl Benz *Kepler *Kopernik *Theodore Maiman *Thomas Edison *Tycho Brahe *Wilhem Maybach	*Albert Einstein *Alessandro Volta *Aziz Sancar *Benjamin Franklin *Braille *ClydeTombaugh *Galileo Galilei *George Simon Ohm *HumphryDavy *Josephine Cochrane *Karl Landsteiner *Thomas Edison *William Herschel	* Isaac Newton *Abdurrahman el-Hazini *Ali Kuşçu *AntonievanLeeuwenhoek *Aziz Sancar *Democritus *Edwin Aldrin Eugene *Ernest Rutherford *Ernst Ruska *Galileo Galilei *Gazi Yaşargil *George Simon Ohm *George Stoney *HansLippershey *Isaac Newton *İbn-iHeysem *James Chadwick *John Dalton *John Joseph Thomson *Kepler *MatthiasSchleiden *Michael Collins *Neil Armstrong *Neils Bohr *Robert Brown *Robert Hooke *Rudolph Virchow	*Alexandre Beguyer de Chancourtois *Archimedes *Benjamin Franklin *Dimitri I. Mendelyev *Glenn Seaborg *Gregor Johann Mendel *Henry Moseley *İngo Potrukos *Jan BaptistvanHelmont *Jan Ingenhousz *Johann Döbereiner *John Newlands *Joseph Priestley *Lothar Meyer *Oktay Sinanoğlu *Peter Beyer *SemaBirler

Grade	Scientists in the 5th Grade Textbook	Scientists in the 6th Grade Textbook	Scientists in the 7th Grade Textbook	Scientists in the 8th Grade Textbook
			*Takiyüddin *Theodor Schwann *Uluğ Bey *Yuri Gagarin	
Total	17	13	31	17

When Table 12 is examined, it is seen that all scientists whose visuals are given or not in the science textbooks are shown. It is understood that there are 78 scientists in total in the science textbooks. It was determined that 70 of the scientists involved were different scientists. Seventh grade level to the most scientists; it has been determined that the least number of scientists is given at the sixth-grade level. It was determined that there were 17 scientists at the fifth-grade level, 13 scientists at the sixth-grade level, 31 scientists at the seventh-grade level, and 17 scientists at the eighth-grade level. It is understood that the scientists in the textbooks are male scientists and 1 female scientist is included. It has been determined that both foreign and Turkish scientists are included in the science textbooks. It has been determined that scientists such as Isaac Newton, Aziz Sancar, Thomas Edison, George Simon Ohm, Galileo Galilei, Kepler and Ali Kuşçu are included in the textbooks.

The findings of the comparison of the features of the scientists with their pictures in the science textbooks examined on the basis of grade level and the drawings of students are given in Table 13.

Table13. Scientists Included in Science Textbooks on the Basis of Grade Level and Scientists Drawn by Students

Grade	Scientist in the Textbook	Characteristics of Scientists Pictured in the Textbook	Student Drawings
5th Grade	*Isaac Newton *Thomas Edison	Gender: 2 Male Face Expression: 2 Thoughtful Physical Appearance: 2 old, 1 longhair; 1 short hair, 1 curly hair; 1 straight hair, 2 white hair, 2 beardless. Clothing and Accessories: 2Shirt, 2 Jacket, 1 Vest, Working Styles: 2 Alone Working Environments: 1 Garden, 1 Laboratory Colour/Black and White: 2 Black and White	Gender:19 Male, 10 Female Face Expression: 8 Thoughtful, 6 Happy, 7 Confused, 3 Sad, 2 Nervous, 2 Excited, 1 Bored Physical Appearance: 21 young; 9 old, 14 long hair; 12 short hair, 16 straight hair; 8 curly hair, 4 moustachioed; 1 bearded, 6 spiky hair, 3 tongue out, 9 hair loss, 9 messy hair Clothing and Accessories: 10 lab coat, 9 glasses, 6 gloves,5 shirt, 2 tie/bowtie,1 jacket Working Styles: 29 alone; 3 in

Grade	Scientist in the Textbook	Characteristics of Scientists Pictured in the Textbook	Student Drawings
			groups Working Environments:19 laboratory, 8 library, 2garden, 2 water, 1 space, 1 theme park, 1 human body, 1 air
6th Grade	*Albert Einstein *Karl Landsteiner *Aziz Sancar *Alessandro Volta *Benjamin Franklin *George Simon Ohm *Thomas Edison *Humphry Davy *Josephine Cochrane	Gender: 8 male,1 female Face Expression: 3 happy, 3 nervous, 3 thoughtful, 1 confused Physical Appearance: 7 old, 2 young,7 short hair; 2 long hair, 6 straight hair; 3 curly hair, 1 hair loss, 6 white hair, 3 dark hair, 6 beardless, 2 moustachioed,1 tongue out, 1 messy hair, Clothing and Accessories: 9 shirt, 8 jacket,5 scarf, 2 bowtie, 2 vest, 1 glasses, 1 medallion, 1 tie,1 fur coat Working Styles: 9 alone Working Environments8 unspecified; 1 library Colour/Black and White: 3 black and white; 6 colour	Gender: 15 male, 13 female Face Expression: 13 thoughtful, 11 happy, 7 confused, 1 sad, 1 nervous Physical Appearance: 27 young; 6 old, 12 long hair; 10 short hair, 14 straight hair; 11 curly hair, 1moustachioed, 2 spiky hair, 5 tongue out, 3 hair loss, 10 messy hair Clothing and Accessories: 19lab coat, 13glasses, 3 gloves,4 shirt, 2 tie/bowtie, 2 hat Working Styles31alone; 2in groups Working Environments:25laboratory, 5 garden, 1library,1 space
7th Grade	*Yuri Gagarin *Galileo Galilei *Uluğ Bey *Isaac Newton *John Dalton *J.Joseph Thomson *Ernest Rutherford *Niels Bohr *James Chadwick *George Simon Ohm	Gender: 10 male Face Expression: 3 thoughtful, 2 happy, 3 nervous 1 excited, Physical Appearance: 6 old; 4 young, 6 short hair; 2 long hair, 3 straight hair; 6 curly hair, 3 hair loss, 4 white hair; 4 dark hair, 5 beardless;3 bearded, 3 moustachioed Clothing and Accessories1space suit, 1 mask 2 glasses, tie; 1 fur coat, 4 bowtie, 3 scarf, 7 jacket, 1 vest, 8 shirt, 1 medallion, 1 sweaters, 1 collar, 1 hat Working Styles: 9 alone; 1 in	Gender: 38 male, 8 female Face Expression: 18 thoughtful, 11 happy, 8 confused, 5 sad, 2 nervous, 1 insidious, 1 bored, 1 excited Physical Appearance: 14 young; 11 old, 17 long hair; 8 short hair, 14 straight hair; 9 curly hair, 6 bearded, 6 moustachioed, 6 spiky hair, 4 tongue out, 1 hair loss, 2 messy hair Clothing and Accessories11lab coat, 10glasses, 5 gloves,2 shirt, 3 space suit, 3 boots, 2 tie/boetie, 2 hat Working Styles: 42alone; 8in groups Working Environments:27 laboratory, 6 garden, 4 space, 2

Grade	Scientist in the Textbook	Characteristics of Scientists Pictured in the Textbook	Student Drawings
		groups Working Environments: 9 unspecified; 1 space, Colour/Black and White: 6 black and white; 4 colour	theme park, 1 human body, 1 air
8th Grade	*Gregor Johann Mendel *Johann Döbereiner *AlexandreBeguyer de Chancourtois *John Newlands *Lothar Meyer *Dimitri I. Mendelyev *Henry Moseley *Glenn Seaborg *Oktay Sinanoğlu *Archimedes *Jan Baptist Van Helmont *Benjamin Franklin	Gender: 12 male Face Expression: 6 thoughtful 4 happy, 2 nervous Physical Appearance:11old; 2 young, 10 short hair; 2 long hair, 7 straight hair; 5 curly hair, 3 hair loss, 9 white hair; 3 dark hair, 5 beardless; 4 bearded, 3 moustachioed Clothing and Accessories:4 glasses, 2 tie; 2 bowtie, 4 scarf, 10 jacket, 5 vest, 3 shirt, 1sweater, 1 collar Working Styles: 12 alone Working Environments: 11 unspecified; 1garden Colour/Black and White: 8 Black and White; 4 Colour	Gender: 24 male,1 female Face Expression: 6 thoughtful, 6 happy, 5 confused, 3 sad, 3 nervous, 1 bored Physical Appearance: 10 young; 15 old, 14 long hair; 3 short hair, 8 straight hair; 11 curly hair, 7 bearded, 2 moustachioed, 2 spiky hair, 1 messy hair Clothing and Accessories: 9lab coat, 8 glasses, 2 gloves,2 shirt, 2 jacket, 2 tie/bowtie, 2 hat Working Styles: 24alone; 1in groups Working Environments:15laboratory, 2garden, 2 space

When Table 13 is examined, it is seen that the features of scientists with their pictures in science textbooks and comparisons of student drawings. It has been determined that there are 33 scientists whose pictures are included in the science textbooks. It is understood that 19 of the scientist images were given in black and white and 14 in colour. In the fifth-grade textbooks, only black-and-white scientist images were presented, in the sixth-grade textbooks the most colour images, and in the seventh and eighth grade textbooks the most black-and-white scientist images were presented. It is understood that in science textbooks, scientists are represented by male figures at every grade level, and by grade levels, scientists are mostly drawn by the male gender. The female figure is only included in the sixth-grade level. In fifth grade textbooks, he is visualized with a thoughtful facial expression, the image of an old and white-haired scientist with curly or straight hair, wearing a shirt and vest. In sixth grade textbooks, scientists are presented as images of happy and thoughtful, tough and angry, old and white-haired, short and straight-haired, beardless, tongue out and messy, wearing shirt and jacket, scarf and glasses. The data obtained from the students' drawings are as follows, with a thoughtful and happy facial expression, young and old, straight and curly hair, beard or beard, moustache, wearing apron, glasses, jacket and shirt, tie or bow tie, wearing a space suit. It has been determined that scientists at each grade level are photographed alone. It is

understood from the table that the students studying at all levels at the secondary school level are drawn by the scientists working alone. It has been determined that generally the working environments are not included in the pictures. However, laboratory and garden at the fifth-grade level, library at the sixth-grade level, space at the seventh-grade level and garden environment at the eighth grade are seen to be prominent. He drew laboratory, garden, space and library environments as the working environment of students at each grade level. Sample photographs of scientists examined in science textbooks are given in Figure 12.

Figure 12. Photographs of Scientists in Science Textbooks (a)Thomas Edison, Grade 5 (Ünver et al., 2020; p.186), b) Aziz Sancar, Grade 6 (Çiğdem et al., 2020; p.234) , (c) Galileo Galile, 7th Grade (Yönter,2021; p.21), (d) Isaac Newton, 7th Grade (Yönter,2021;p.67),(e) Gregor Johann Mendel, 8th Grade (Yigit, 2021; p.34).

The general summary findings of the scientists, the scientists whose pictures are included, and their genders in the science textbooks examined on the basis of grade level are given in Figure 13.

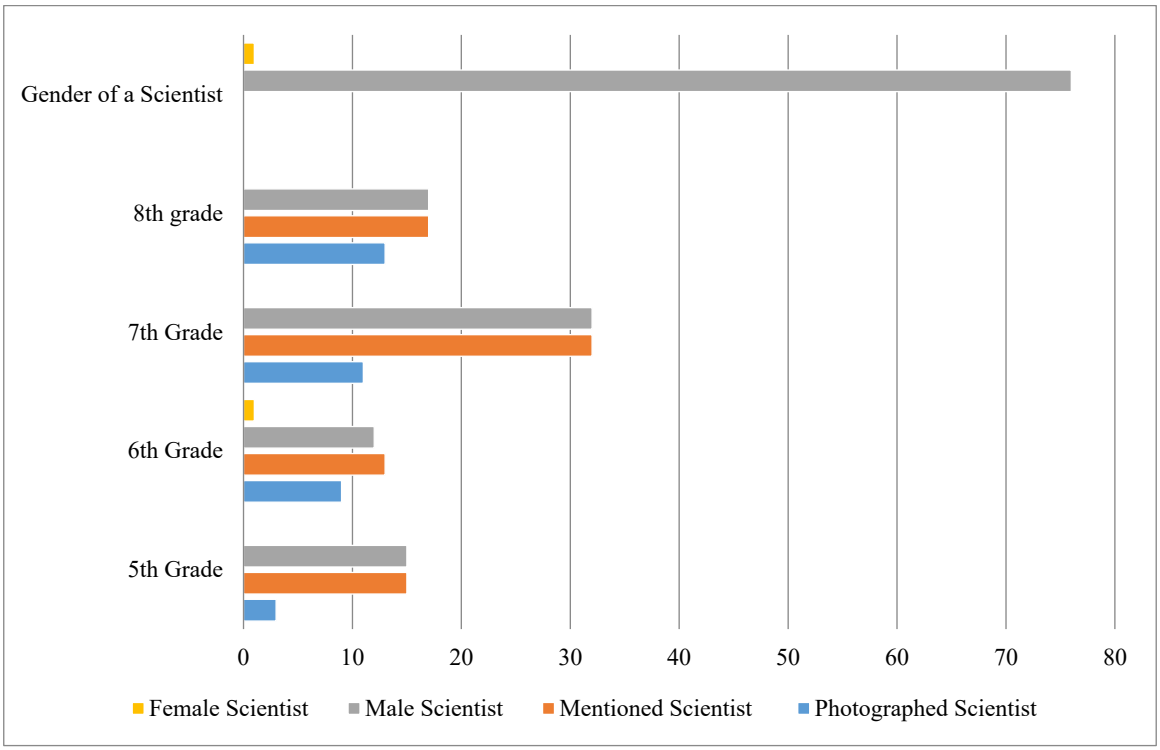

Figure 13. Scientists in Science Textbooks

When Figure 13 is examined, it has been revealed that a total of 78 scientists are included in the science textbooks, which are examined for the subject area at all levels, at the secondary school level. It was determined that 69 of

the scientists included were different scientists. There were 33 scientists whose photographs were found in the textbooks. It was determined that 2 pictures of the scientists with the visuals were in the 5th grade science book, 9 of them were in the 6th grade science book, 10 of them were in the 7th grade science book and 12 of them were in the 8th grade science book.

Discussion and Conclusion

In the study, the perceptions of secondary school students about scientists were revealed through drawings and their change on the basis of grade level was determined. The effect of the examined science textbooks on the science perceptions of secondary school students was examined. They give more place to the male scientist figure than the female scientist figure by the students. This result will be supported by the fact that the scientists included in the science textbooks are male and 1 female scientist is included. It was determined that the class level depicting a female scientist was at most 5th and 6th grade students, and at least 8th grade students. Therefore, it can be stated that the probability of drawing male figures increases as the education level of secondary school students increases. It contradicts the idea that students should draw female scientists in direct proportion to their level. Similarly, the level of science textbook, which includes female scientists, is in the sixth grade. Therefore, it can be concluded that science textbooks are effective on students' images of scientists. In addition, the fact that women are not sufficiently represented in the fields of science and that women are not given much space through mass media or social media (Miller, Nolla, Eagly & Uttal, 2018) can be associated with the tendency of students to draw male figures in the gender of scientists. Similarly, in the studies in which students' images of scientists were revealed in the literature, the fact that students painted male scientist images is in line with the results of the current study. (Ahi & Özsoy, 2014; Akçay, 2011; Bozzato, Fabris & Longobardi, 2021; Emvalotis & Koutsianou, 2018; Gounsoulin, 2001; Harman & Şeker, 2017; Kara &Akarsu, 2013; Kaya, Doğan & Öcal, 2008; Korkmaz & Kavak, 2010; Nuhoğlu & Afacan, 2007; Özdemir, 2019; Özel, 2012; Rabaza, 2011; Ruiz-Mallén & Escalas, 2012; Samaras, Bonoti & Christidou, 2012; Thomson, Zakaria & Radut-Taciu, 2019; Yontar Toğrol, 2000 ; Türkmen, 2008). On the other hand, this may be a sign that from past to present, the male scientist judgment continues in student images and this prejudice has not been destroyed. At this point, the need to include more female scientists in textbooks comes to the fore. On the other hand, it is recommended that this judgment can be overturned by highlighting more female scientist figures among the sources (media, novels, magazines, films, etc.) followed by the students. By aiming to eliminate the direct association of male gender when the word scientist is mentioned, students should be brought together with female scientists or active participation of female students in science studies should be ensured.

It was determined that the students generally tended to draw a thoughtful and happy facial expression of the scientist. It was determined that the 7th grade students drew the most in the thoughtful and happy mode, followed by the 6th graders. A very small group of students drew a scientist with a confused, sad and angry facial expression. The connotation is created that the scientists included in the textbooks generally show a thoughtful attitude and make an effort to reveal something. At this point, presenting thoughtful scientist images in textbooks at all grade levels supports student drawings at every grade level. On the other hand, not encountering very happy scientists photos and encountering hard-tempered images can reduce the effect of textbooks on drawing happy

facial expressions. When the literature is examined, scientists are seen with happy facial expressions (Ahi & Özsoy, 2014; Harman & Şeker, 2017; Kara & Akarsu, 2013; Kaya, Doğan & Öcal, 2008; Picard & Boulhais, 2011), friendly faces (Bozzato, Fabris & Longobardi, 2021) and students who draw with a smile (Özdemir, 2019) provide the current study results. The finding by Miller, Nolla, Eagly & Uttal (2018) that the number of drawing scientists unhappy with the increase in grade level increases in parallel with the finding in the current study that eighth graders indicate the least happy image.

Secondary school students symbolized scientists as young individuals. It would not be correct to say that the images of scientists included in the textbooks are presented as middle-aged and elderly, and that the textbooks will be the source of the students' coding as scientists as young people. It can be stated that the image of young scientists formed in students may be a source of science teachers being young individuals. However, based on student levels, it was determined that the eighth graders drew the scientist as the oldest, which strengthens the possibility that they were under the influence of the elderly figures in the textbooks. In this sense, it is clear that as the grade level increases, the perception of harsh and nervous scientist is settled in the textbooks. There are studies that include current findings in which scientists who agree with our study are expressed as young (Akçay, 2011; Bozdoğan, Durukan & Hacıoğlu, 2018; Christidou et al., 2016; Emvaloti & Koutsianou, 2018; Hillman, Bloodsworth, Tilburg, Stephan & Henrietta, 2014; İvgin, Akçay & Kapıcı, 2021; Meyer et al., 2019; Özdemir, 2019). At this point, it can be seen as a pleasing result that the perception of elderly scientists in individuals is increasingly broken and a young scientist representation is formed in the minds of students. On the other hand, studies that include drawings depicting scientists at an old and advanced age contradict the results of the current study (Rabaza, 2011; Ruiz-Mallén & Escalas, 2012; Türkmen, 2008). The description of long hair and beard by seventh grade students, at most, brings to mind the possibility that photographs of Isaac Newton with long hair and Galileo Galile with a beard can be the source. The fact that the fifth and sixth grade levels depict the scientist with short and straight hair highlights the idea that they may have been inspired by the photographs of Aziz Sancar in the Thomas Edison sixth grade book in the fifth grade book. The physical-looking scientist with short hair and a mustache was found in the drawings of eighth grade students. This situation may be related to the drawing of scientists such as Oktay Sinanoğlu, George Mendel with short hair, and the drawing of scientists such as Henry Moseley, Beguyer de Chancourtois with mustache and short hair. It is clear that the presence of scientists with physical qualities such as long and short hair, curly and straight hair, beard or beardless, mustache in every grade level in science textbooks supports student drawings. Therefore, it can be easily stated that the physical characteristics of the scientists in the textbooks coincide with the perceptions of the scientists formed by the students. In addition, the scientist with spiky hair and a physical appearance with his tongue out may be symbolized by the stereotypical Albert Einstein photograph included in most sources. Likewise, the effect of the image of the scientist with his tongue out or with messy hair in the textbooks should not be overlooked. Similarly, our study findings will be supported by the literature, such as beard and messy hair (Güler & Akman, 2006), straight hair and messy (Camcı Erdoğan, 2008; Küçük & Bağ, 2012), messy and bald Özel (2012), mustache and beard (İvgin, Akçay & Kapıcı, 2021) There are studies that illustrate scientists with physical appearances.

Students defined scientists as individuals who usually wear lab coats, goggles and gloves, or wear an astronaut suit. The presence of figures of scientists wearing glasses is striking at every level of the textbooks. On the other

hand, the images of scientists in the textbooks stand out with their shirts, jackets and ties/bowties. Finding clothing styles such as shirts and jackets in the drawings of students studying at every grade level reveals that they were influenced by the textbooks. However, the expected number of scientists wearing lab coats was not encountered in the textbooks. Therefore, it would be correct to say that the possibility of high-level effectiveness of textbooks in the context of clothing and accessories has disappeared. At this point, sources about various scientists followed by individuals and stereotypes drawn in social media come to mind. Likewise, in the literature, it is emphasized that factors such as books, movies, magazines, comics, television programs shape scientist stereotypes in individuals (Emvalotis & Koutsianou, 2018; Karaçam, Bilir & Danışman, 2021; Long vd., 2010; Steinke vd., 2007). On the other hand, many national and international studies carried out in the literature reveal that students describe scientists with lab coats and glasses (Akçay,2011; Bozzato vd., 2021; Ferguson & Lezotte, 2020; Gounsoulin, 2001; Güler & Akman, 2006; İvgin, Akçay & Kapıcı, 2021; Kara & Akarsu, 2013; Kaya, Doğan & Öcal, 2008; Mallen & Escalas, 2012; Özel, 2012; Rabaza, 2011; Samaras, Bonoti & Christidou, 2012; Thomson, Zakaria & RadutTaciu, 2019; Türkmen, 2008).

It has been determined that there is a judgment among students that scientists generally work alone and in closed working environments. The students symbolized the scientist working in the laboratory environment the most, followed by the scientist working in the garden, library and space environment. It is not surprising that in the textbooks, scientists are generally photographed alone, and the image of a single scientist working in the minds of students is not surprising. The lack of place for scientists working in groups at the expected level can be associated with the inference that students are perceived as a social individuals and individuals who prefer to live on their own. The literature studies, which are consistent with the findings of the study, indicate that scientists work alone. (Çakmakçı, Tosun, Turgut, Örenler, Şengül & Top, 2011; Christidou, 2010; Harman & Şeker, 2017; İvgin, Akçay & Kapıcı, 2021; Ruiz-Mallén & Escales, 2012). In an effort to emphasize the collaborative nature of scientists working in groups, students should be provided with opportunities to do scientific studies together with their peers. On the other hand, the textbooks include working environments to describe the laboratory, garden, library and space. It is understood that the study environments reached in the student drawings and the study environments presented in the textbooks intersect. Due to the prominence of the space environment in the seventh-grade textbooks, it is considered natural that the space environment is drawn by the seventh-grade level at most. At this point, it is stated that the reflections of the scientists formed in the students on the images of the working environment and form are seen in the textbooks. Although the effect of the study environments of the textbooks has been striking, it cannot be said that the students are affected face-to-face by the textbooks in the context of the scientist working environment, as there are portrait pictures of scientists in the textbooks in general. Likewise, the finding that scientists work indoors such as laboratories and libraries overlaps with many studies in the literature (Akçay, 2011; Bozdoğan vd., 2018; Bozzato vd., 2021; Camcı Erdoğan, 2008; Duran & Bayar, 2019; Emvalotis & Koutsianou, 2018; Ferguson & Lezotte, 2020; Mallen & Escalas, 2012; Nuhoğlu & Afacan, 2011; Özdemir, 2019; Rabaza, 2011; Ruiz-Mallén & Escalas, 2012). In order to destroy the perception of scientists working only in indoor environments, it is recommended that students organize scientific activities outdoors.

It has been determined that the students' research symbols are tables, laboratory materials, test tubes, magnifying glasses, rulers and chemicals. Since the perception of scientists doing research, discovery, discovery and writing

at a desk takes place in students, it is natural to encounter desk drawings the most.In addition, it can be argued that the research symbols of equal-arm scales and dynamometers were drawn by the seventh graders and that the subject areas were weight and mass. In the studies of scientist perception in the literature, test tubes from table and glass materials are generally encountered as research symbols. (Ahi & Özsoy, 2014; Bozzato et al., 2021; Harman & Şeker, 2017; Kara, 2013; Korkmaz & Kavak, 2010; Nuhoğlu & Afacan, 2011; Özdemir, 2019). It has been determined that formulas, numbers, letters, blackboards, cabinets, note papers, pencils and modeling drawings are expressed as information symbols. Similarly, in literature studies, formulas (Bozzato et al., 2021), table, book and cabinet (Akçay, 2011; İvgin, Akçay & Kapıcı, 2021; Kara, 2013; Nuhoğlu & Afacan, 2011), glassware (Ahi & Özsoy, 2014) information symbols have taken place. On the other hand, it was revealed that the fifth and sixth grades included the concepts of earth, sun and stars, the seventh grades included the concepts of space, gravity and atomic models, and the eighth grades included the concepts of acid-base and periodic table in their drawings. At this point, it is clear that secondary school students have made the associations of the symbol of knowledge based on the subject of the unit at their own grade level. Again, the effect of school, teachers and textbooks can be revealed. Newton made drawings by secondary school students associating the famous scientist with gravity and apple information symbols. At this point, it can be deduced that the story of Newton and the apple falling from the tree, which has been told to students from past to present, may have shaped the image of the scientist that took place in the students. Erten, Kıray & Şen-Gümüş (2013) supports the view that scientific stories can have an impact on students' ideas about science and scientists.

Microscope, spacecraft, computer, machine, telescope, robot and vaccine drawings were found under technology and invention by students. Since the microscope came to the fore in the historical development of the cell in the 7th grade textbook, the possibility that microscope drawings were made at the 7th grade level comes to mind at most. Similarly, it is not surprising that individuals who draw telescopes and spacecraft are in the 7th grade, with the 7th grade subject area oriented towards space studies. In addition, it can be suggested that inventions such as robots and machines that fulfill a utopian purpose were drawn by younger students, and that some students were still under the influence of cartoons or stories that were far from reality. In addition, it is an expected result that each secondary school grade level indicates the computer as a technology product. Evidence can be presented that on the one hand, students can constantly use the computer for the purpose of doing research homework in their teaching processes, and on the other hand, they may have coded the computer in their minds as a device where researchers record data. It can be presented as a justification for the students to mention the vaccine as a technology and invention product, the fact that researchers carry out studies to find a vaccine in order to protect against the Covid-19 pandemic, which has emerged in our country in recent years, and that it is constantly conveyed through the media. The existence of student drawings of technology-invention products in the literature supports our current study. Computer and telescope (Harman & Şeker, 2017), microscope and telescope, space vehicles (Ahi & Özsoy, 2014), machine and microscope (Kara, 2013), smart robots (İvgin, Akçay & Kapıcı, 2021), computers and robots (Özdemir, 2019; Samaras, Bonoti and Christidou, 2012; Türkmen, 2008). Cairns, Dickson & McMinn (2021) revealed that secondary school students stated that scientists do not use technology and that devices with ease of use do not intend to use the technology option. Therefore, the aforementioned study is in a position to meet the result that students include more stereotypical inventions.

Within the framework of the study, it was determined that the most famous scientists drawn by the students were Isaac Newton, Albert Einstein, Aziz Sancar Ali Kuşçu, Thomas Edison scientists. The fact that Isaac Newton is mostly drawn at the fifth and seventh grade levels can be explained by the fact that Newton is mostly included in the fifth and seventh grades in science textbooks. A connection can be made with the fact that the Galileo Galilei scientist is included in the seventh grade and the Thomas Edison scientist is the fifth grade, and that the same scientists are included in the space and electricity units in the science textbooks. On the other hand, the fact that scientists who have worked in the field of chemistry can be found in the drawings of the seventh and eighth grades can be associated with the concentration of scientists on atomic models and periodic table in chemistry in the textbooks of the aforementioned levels. (For example; James Chadwick, Dimitri Mendeliev, Neils Bohr, Henry Moseley etc.). The fact that there are studies in the literature that include famous scientists Isaac Newton, Albert Einstein, Aziz Sancar Ali Kuşçu, Thomas Edison in the drawings of secondary school students is in line with our study findings. (Ahi & Özsoy, 2014; Bozdoğan, Durukan & Hacıoğlu, 2018; Harman & Şeker, 2017; İvgin, Akçay & Kapıcı, 2021; Korkmaz & Kavak, 2010). Although secondary school students gave a lot of space to foreign scientists in their drawings, they did not include much of Turkish scientists. Only Aziz Sancar and Ali Kuşçu scientists take part in student drawings. Similarly, the fact that a small number of Turkish scientists are found in textbooks is an indication that this situation is not surprising. Including the scientists Aziz Sancar and Ali Kuşçu, Gazi Yaşargil, Uluğ Bey and Oktay Sinanoğlu in the textbooks is obviously a source for the scientists included in the student drawings. The finding by İdin & Yalaki (2016) that western scientists are more involved than Turkish scientists in science textbooks and that they are not given enough place, is in line with the results of the current study. In order to increase the perception of Turkish scientists among students, there is a need to include more Turkish scientists in textbooks.

It is suggested that the stereotypical perceptions of scientists and their working environment styles that take place in students may be caused by the images of earth scientists and their environments presented in science textbooks. In the study by Karaçam, Aydın & Digilli (2014), in which the images of scientists in the science textbooks were examined, the result that the stereotypical images in the students overlap with the textbooks forms the basis of the current study. Similarly, El Takach & Yacoubian (2020) stated that the stereotype images of the students conflict with the textbooks. The textbook is seen as the determining factor in science education and students' understanding of science (Christidou, Bonoti & Kontopoulou, 2016). Therefore, considering the existing effect of textbooks in shaping stereotypes that take place in students, the need to organize science textbooks comes to the fore at the first stage. On the other hand, scientists' tendencies in teachers who play a role in the teaching process can be shown as another justification for the science images formed in students. Teachers may not only emphasize the stereotypes of students and tend to support the stereotypical views of scientists (Uçar & Sanalan, 2011).Teaching and learning about science as scientific research helps students better understand the nature of science and the work of scientists. Teachers have important responsibilities in shaping positive images of scientists by students and students exhibiting participatory actions (Bağ, 2013; Finson, 2002; Ruiz-Mallén & Escalas, 2012). Meyer et al., (2019) point out that school and education contexts will be effective in shaping images of science. In the literature, it can be said that determining that teachers and prospective teachers have stereotypical perceptions of scientists and working styles strengthens the possibility of students reflecting their stereotypical science images. (Ağgül Yalçın, 2012; Arslan & Kartal, 2021; Bartan, 2019; Bilir, Türk & Tüzün, 2020; Çermik, 2013; Kırıkkaya,

Bozkurt & İşeri, 2011; Özkan, Özeke, Güler & Şenocak, 2017; Şentürk, 2020 ; Ürey , Karaçöp, Göksu & Çolak, 2017). Science camps (Leblebicioğlu, Metin, İlker, Çetin, 2011), different scientific activities (Deniş Çeliker & Erduran Avcı, 2015), conceptual change and visiting scientist activities (Karaçam et al., 2021), telling stories about the lives of scientists (Erten et al., 2013) are expected to increase the necessary activities and scientific activities or to ensure sufficient participation of the students on the grounds that they can positively affect the perception of scientists.

It would not be wrong to state that there are stereotyped scientist image judgments in secondary school students when viewed from a general framework. Although there is no remarkable or significant difference on the basis of class level, it can be stated that stereotype perceptions increase inconspicuously as the class level increases. In the study, in which the articles published by Ferguson & Lezotte (2020) in 2003 and 2018 were examined and meta-analyzed, it was concluded that students' perceptions of scientists remained largely consistent over a changing time period. Therefore, the stereotypical scientist perception of the students in the study is strengthened.

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Author Information

Kevser Arslan

https://orcid.org/0000-0003-0658-7175

Yildiz Technical University

Istanbul

Turkey

Contact e-mail: *arslankevser96@gmail.com*

Hakan Akçay

https://orcid.org/0000-0003-0307-661X

Bogazici University

Istanbul

Turkey

Hasan Ozgur Kapici

https://orcid.org/0000-0001-7473-1584

Bogazici University

Istanbul

Turkey