

# A COMPARATIVE INVESTIGATION ON THE CHARACTERISTICS OF SCIENTISTS IN SOCIAL STUDIES TEACHING

**Sezgin ELBAY<sup>1</sup>**

Dr., MEB, sezgin\_elbay@hotmail.com, ORCID: 0000-0002-0601-8063

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## ABSTRACT

This research was conducted to compare two situations that seem to be independent from each other. In this context, the opinions and images of middle school 6<sup>th</sup> grade students towards scientists and the scientists profile in the Science, Technology and Society unit of the social studies textbooks (4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grades) that the students have been exposed to so far were compared. For this reason, the research was carried out according to the document analysis and holistic single case study method. The study group of the research consisted of 27 (female=14, 52%; male=13, 48%) students aged 11-12, determined according to the criterion-case sampling method; in addition, social studies textbooks (4<sup>th</sup>, 5<sup>th</sup> and 6<sup>th</sup> grades) created a Science, Technology and Society unit. Datas were collected through open-ended questionnaire, drawing and scientist identification forms. Documentary and descriptive analyzes were made on the obtained datas. As a result of the analysis, it was concluded that the opinions and images of the students towards the scientist and the profile of the scientist in the Science, Technology and Society unit largely overlapped. In line with these results, Social Studies textbooks should include scientists study in the area of social science as well as scientists study in the area of science, mathematics / medicine in the learning area of "Science, Technology and Society".

**Keywords:** Social studies teaching, the learning area of Science, Technology and Society, characteristic features of scientists

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## Introduction

Science has a feature that encompasses every aspect of society. Science aims to develop social relations from the individual's being at peace with himself and reaching inner peace so that people can live more comfortably; it even shows its effect in almost every area from construction to health. This situation also indicates that science has a structure that develops in the focus of natural sciences and social sciences. In this sense, individuals who deal with science or social sciences and produce scientific knowledge are called scientists. Scientists; they represent exemplary personalities in society with their industriousness, objectivity, researcher identities and sense of curiosity. For this reason, the studies of scientists and scientists constitute an important place in the field of education.

Scientists generally try to discover natural/social events and phenomena. They benefit from scientific method and scientific process skills during their studies. However, students can develop various and different kinds of prejudices and stereotypes about scientists and their work that can mislead them. As a result of this situation, students perceive scientists as individuals who usually wear lab coats, wear glasses, work in laboratories, have messy hair and beards (Farland Smith, Finson, Boone & Yale, 2012). Although this opinion/image is a pleasant stimulus for some students, it causes many students to move away from being scientists (Bilir et al., 2020). Moreover, molding the opinion/image of a scientist may cause students to be reluctant to conduct scientific studies (Kara & Akarsu, 2013). In this context, it is necessary to investigate the opinions/images of the students about the scientist in the courses whose theme (learning area) or one of the sub-themes is "science, scientist, and scientific studies". One of these courses is the Social Studies course.

When the Social Studies course is examined, it is seen that this course is designed in accordance with 7 themes. One of these themes is "Science, Technology and Society". In this theme, of students; that innovative, critical and scientific thinking is the basis of developments in science and technology; by understanding the development process of science and technology and its effects on social life, they are expected to acquire the ability to use technology to reach information. In addition, it is aimed that students get to know scientists who work in different fields (Ministry of National Education [MoNE], 2018; National Council for the Social Studies [NCSS], 2010). However, stereotypes of students towards scientists are an obstacle both in realizing these purposes and in students' critical and scientific thinking. Moreover, the skill of recognizing stereotypes, prejudice, and the value of being scientific in the Social Studies Curriculum (MoNE, 2018) are negatively affected by this situation. In the studies and researches carried out, results have been reached to support this judgment.

In the studies conducted, it was determined that the students had stereotypes about scientists (Christidou, 2010; Harman & Şeker, 2017; Makarova & Herzog, 2015; Medina-Jerez, Middleton & Orihuela-Rabaza, 2011; Song & Kim, 2010). In many studies conducted in this sense, it has been concluded that there is a stereotypical perception of scientists in the profile of "a male scientist in a white coat, working alone in a laboratory" (Doğan, 2015; Emvalotis & Koutsianou, 2018; Kara & Akarsu, 2013; Küçük & Bağ, 2012; Narayan, Park, Peker & Suh, 2013; Özdemir & Ünal, 2020; Özsoy & Ahi, 2014). One danger of this is that research findings have been reported that female students who thought scientists were only boys were unable to think of themselves as scientists (Huang, Shih, Chen & Liu, 2015).

The basis of understanding the nature of science is knowing the scientist correctly (Bilir et al., 2020). Creating the right image of scientist, especially in students who are the guarantee of the future, also affects their career choices (Finson, Beaver & Cramond, 1995). Students create their own images of scientists and scientists in or out of school, and these images resist change according to other information learned at school (Kara & Akarsu, 2013).

Science and scientist images have a complex structure that is influenced by school and textbooks, teacher behaviors, teacher's personality, after-school activities, television, cartoons and science fiction books (Türkmen, 2008). As can be understood from this explanation, textbooks are a fundamental factor in shaping perceptions or opinions towards science and scientists. Moreover, according to social studies education researchers, textbooks are the teaching material most frequently used by teachers in social studies classes, and teachers spend most of their lesson time using textbooks (Şahin, 2012).

It is known that the most basic purpose of the Social Studies course is to raise active citizens. It is suggested that one of the indicators of active citizens is individuals with scientific and critical thinking skills (NCSS, 2010). In this context, students' learning about scientists and their studies in the teaching process can support their scientific and critical thinking (Karasu Avcı & Faiz, 2019). For this reason, since the 2005 curriculum change in Turkey, in social studies textbooks; scientists, their discoveries and their life stories have begun to be included. In the studies and researches carried out in connection with this, it has been tried to reveal how scientists are included in social studies textbooks.

In some studies, the ethnic origins and religious structures of scientists in social studies textbooks were examined (Akalin, 2019; Karasu Avcı & Faiz, 2019; Ulu Kalın, 2018). In addition, it has been tried to reveal the fields in which scientists work together with their ethnic origins and religious structures (Osmanoğlu & Cantemür, 2020; Topçu & Karatekin, 2017). In the study conducted by Bayram (2018), it was determined that one of the most basic factors affecting the image of scientists that students have is textbooks. However, a holistic research on the physical, professional and personal characteristics of scientists in social studies textbooks has not been conducted. However, in order for students to know scientific developments and the formation of science branches, they should recognize the professional qualifications and personality traits of scientists (Kaya et al., 2013). In addition, the inability to know whether or not there are stereotyped images about the physical characteristics of scientists in social studies textbooks causes a deficiency in revealing the critical variables of students' prejudices and stereotypes on this subject.

Since textbooks can affect students' opinions and images of scientists, the profile of scientists in both textbooks and students should be investigated comparatively. In this way, it can be revealed whether there is a concordance between the tendency in the textbooks for the scientist profile and the opinions of the students. For these reasons, the deficiencies in the literature in this direction should be eliminated with research and/or studies to be carried out. In this framework, the aim of this research is to comparatively investigate the opinions and images of middle school 6<sup>th</sup> grade students towards scientists and the profile of scientists in the Science, Technology and Society unit of social studies textbooks. The factors that are subject to comparison are as follows: gender, appearance, personal characteristics, work preference, study area, workplace, tools and equipment. The sub-questions formulated based on the purpose of the research are as follows:

*1- Gender statuses:*

- a) What are the gender status of scientists according to students?
- b) What are the gender statuses of the scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

*2- Appearance*

- a) According to the students, what are the physical appearances of scientists?
- b) What are the physical appearances of the scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

*3- Personal characteristics:*

- a) According to the students, what are the personal characteristics of scientists?
- b) What are the personal characteristics of the scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

*4- Working preferences:*

- a) What are the study preferences of scientists according to students?
- b) What are the study preferences of scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

*5- Study areas:*

- a) According to the students, what are the areas of study of scientists?
- b) What are the study areas of the scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

*6- Working places:*

- a) According to the students, what are the working places of scientists?
- b) What are the working places of the scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

*7- Tools and equipment:*

- a) According to the students, what are the tools and equipment used by scientists?
- b) What are the tools and equipment used by scientists in the Science, Technology and Society units (4, 5 and 6<sup>th</sup> grades)?

## Method

### Design

In one aspect, this research is based on the following; since it was conducted to determine the physical, professional and personal characteristics of scientists in the Science, Technology and Society unit of 4, 5 and 6<sup>th</sup> grades Social Studies textbooks, document analysis method was used. Document analysis; it is a method used in collecting, systematically examining and evaluating official or private records (Frey, 2018). In this sense, document records; it consists of written, visual and physical materials. In this research, document analysis method was used because written records were analyzed.

Secondly, since the students' opinions (images) were examined, a holistic single case study design was used in the study. According to Patton (2002), the purpose of holistic single-case studies is; it is to collect comprehensive, systematic and in-depth information about a situation of interest. The holistic situation discussed in this research is how scientists reflect on the opinions of 6<sup>th</sup> grade students. In this context, units of analysis are "opinions" and "images" that support the emergence of these opinions. Since 6<sup>th</sup> grade students, and their opinions (images) about the scientist create a specific context, a holistic single case study design was used in this research (Yin, 2014).

### Participants

In line with the purpose of the research, the study group of the research; In 2019, 6<sup>th</sup> grade students studying in an official secondary school affiliated to the MoNE and Science, Technology and Society unit, which is included in social studies textbooks, created. The study group of the research was selected according to the criterion-case sampling method. The main criterion in the selection of 6<sup>th</sup> grade students: The achievements in the 4, 5 and 6<sup>th</sup> grades Science, Technology and Society learning area are related to the characteristics of science, scientific study areas, scientists and scientists. As a matter of fact, 6<sup>th</sup> grade students have had the competence to express their opinions on this issue, as they have been subjected to a 3-year education on scientists until now. In addition, no selection was made among these students; all students attending the 6<sup>th</sup> grade of a randomly selected secondary school were included in the study. Various demographic information of the students is presented in Table 1.

**Table 1.** Demographic Characteristics of Students according to Various Variables

Demographic features			
		f	%
Gender	Female	14	52
	Male	13	48
Age	11	25	93
	12	2	7

In addition, since the opinions and images of 6<sup>th</sup> grade students about scientists are affected by the textbooks, the Science, Technology and Society unit of the social studies textbooks (4, 5 and 6<sup>th</sup> grades) that the students are exposed to for 3 years have been accepted as a basic criterion. The data on the textbooks are given in Table 2.

**Table 2.** Data on Textbooks

Name of the textbook	Related publisher	Author	Publication year
Primary School 4 <sup>th</sup> Grade Social Studies Textbook	MoNE	Commission	2017
Secondary School and Imam Hatip Secondary School 5 <sup>th</sup> Grade Social Studies Textbook	Anadol	E. Şahin	2018
Secondary School and Imam Hatip Secondary School 6 <sup>th</sup> Grade Social Studies Textbook	MoNE	Yılmaz et al.	2018

## Data Collection Tools

### *Open ended questionnaire form*

The open-ended questionnaire was prepared in order to learn the opinions of the students about the scientist, taking into account the information in the literature. There are 4 questions in total in the form. The survey questions prepared by the researcher and examined by 2 social studies educators were asked to 5 students at the same grade level before being asked to the participants, and they were made ready for application by making necessary corrections and changes according to the feedback of the students.

### *Drawing form*

When the literature is reviewed; there are many studies showing that pertaining to scientists' opinions of participants in different age ranges are revealed by drawing (Harman & Şeker, 2017; Kara & Akarsu, 2013; Narayan et al., 2013; Özsoy & Ahi, 2014). The drawing used in this research; "Draw a scientist", which aims to reveal the scientist in the minds of the students. It is a data collection tool that contains the expression before the application, a pilot application was conducted with 5, 6<sup>th</sup> grade students in order to check whether the statement in the data collection tool was sufficient and understandable to reveal the scientist in the minds of the students. After the application, the students' drawings were interviewed and the students understood the expression in the data collection tool; it was determined that they drew accordingly.

### *Scientist determination form*

This form was prepared by the researcher in order to determine the various characteristics (such as personal, physical and professional) of the scientists in the Science, Technology and Society unit of the social studies textbooks (4, 5 and 6<sup>th</sup> grades) in line with the purpose of the research. A table indicating the characteristics of scientists was prepared in the form. In the table, there are sections such as "scientist, gender, appearance, personal characteristics, work preference, study area, work place, and tools", respectively. This form was filled by 2 social studies experts independently of each other. As a result of the filling, a 100% agreement was obtained.

## Data Analysis

In the study, two different data analysis methods were used because different data were collected. First of all, the relevant unit of the textbooks (Science, Technology and Society) document analysis; afterwards, student opinions and drawings were analyzed through descriptive analysis.

The stages of document analysis are as follows (Yıldırım & Şimşek, 2016):

1. Accessing the documents: 3 different textbooks were accessed electronically.
2. Checking the originality: The textbooks examined are the ones taught in schools with the permission of the MoNE Board of Education and Discipline.
3. Understanding the documents: The Science, Technology and Society unit of the textbooks in Table 2 were read thoroughly and general concepts and names (related to science, scientist, invention, etc.) were determined.
4. Analyzing the data: The documents were analyzed in four stages.
  - Selecting a sample from the data subject to the analysis: A total of 3 textbooks belonging to 2 different publishing houses in the study group of the research were examined.
  - Developing the categories: The categories created in line with the purpose of the research are as follows: gender, appearance, personal characteristics, working preference, study area, working place, and equipment.
  - Determining the analysis unit: All texts and images in the Science, Technology and Society unit were determined as the analysis unit.
  - Digitization: The number of times each category is repeated in a book is determined by giving a value of "0" if there is no category in each textbook, and "1" if there is.

In addition to this, descriptive analysis was conducted in two ways, regarding opinions and drawings. Descriptive analysis is coding the data set according to pre-existing structures and/or categories (Hatch, 2002). For this, first of all, open-ended survey data were included in a typological category. These categories are: gender, appearance, personal characteristics, work preference, study area, workplace and equipment. Then, the data were analyzed in accordance with the category types. In this framework, words and/or phrases that may be related to categories were searched in the data. After revealing the relationships between categories and words and/or phrases, data patterns were created that connect the data to categories. In the last stage, direct quotations

that could support the categories were searched in the data.

A checklist was prepared to analyze the drawing and scientist identification forms. While preparing the checklist, the categories created in the study conducted by Finson et al. (1995) were used because it provided more detailed information. These categories are: Appearance (such as lab coat, glasses, beard, and mustache), research symbols (tools), information symbols (books, cabinets, boards, pens, etc.), technology (products of science), workplace, and gender, stereotypes (scientist working indoors, middle-aged or elderly scientist). Analysis results are presented in the findings section with frequency and percentage values in the tables created.

**Trustworthiness (Validity and Reliability)**

Three experts from the area of social studies were consulted to achieve consensus among coders to code separately and independently of each other, based on the entire data set. Miles & Huberman (1994) reported that a consensus of at least 80% can be considered sufficient for inter-coder consensus. As a result of the examinations, 92% agreement was achieved between the opinions of the experts. Finally, participant confirmation was obtained for the entire data set and triangulation was carried out in the data collection tools.

**Findings**

**1. Gender Statuses:**

**a) Gender status of scientists according to students**

The students' opinions on the gender status of scientists are presented in Table 3.

**Table 3.** Gender Status of Scientists according to Students

Participants	Gender of scientists			Participants	Gender of scientists		
	Male	Female	Intersex		Male	Female	Intersex
Abdi	*			Kerime	*		
Abdülatif	*			Mehmet	*		
Bekir	*			Melda	*		
Berkut	*			Menşure	*		
Berrin		*		Müslüm	*		
Ceren		*		Narin		*	
Ece		*		Niran	*		
Gonca		*		Özlem	*		
Halit	*			Sefa	*		
Hami	*			Selin		*	
Hasan	*			Suna			*
İpek	*			Yasemin	*		
İsmail	*			Yasin	*		
İsmet	*			Total (27)	20 (%74)	6 (%22)	1 (%4)

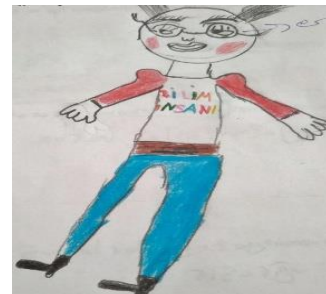
Some illustrations showing the gender status of scientists are presented in Figures 1, 2, and 3.



**Figure 1.** İsmet's drawing



**Figure 2.** Ceren's drawing



**Figure 3.** Suna's drawing

When Figure 1 is examined, it is seen that the student codenamed İsmet has drawn the scientist as a male; when Figure 2 is examined, it is determined that the student codenamed Ceren draws the scientist as a woman, and when Figure 3 is examined, the student codenamed Suna draws the scientist as having an ambiguous sexual orientation (intersex). In the coding made to determine the genders; based on “*hair, facial hair, and make-up applied to the face (such as lipstick)*”. In particular, Suna's portrayal of the scientist as bald, despite the fact that she draws her make-up and long eyelashes; moreover, as a result of the interview with her, the statement “*it will not necessarily be a man or a woman*” towards scientists shows that Suna thinks of a scientist as a person with a different sexual orientation.

**b) Gender status of scientists in the Science, Technology and Society unit**

The gender status of the scientists in the Science, Technology and Society unit is presented in Table 4.

**Table 4.** Gender Status of Scientists in Science, Technology and Society Unit

Scientist	4 <sup>th</sup> grade		Scientist	5 <sup>th</sup> grade		Scientist	6 <sup>th</sup> grade	
	Gender			Gender			Gender	
	Male	Female		Male	Female		Male	Female
A.G. Bell	*		A.G.Bell	*		Y. Halaçoğlu	*	
C.F. Benz	*		Einstein	*		A. Einstein	*	
T.A. Edison	*		Edison	*		Osman Turan	*	
G. Marconi	*		Newton	*		Hulusi Behçet	*	
J.L. Baird	*		Sancar	*		Aziz Sancar	*	
N. Conte	*		C. Arf	*		Gazi Yaşargil	*	
Wright	*					N. Gökdoğan		*
brothers						Refik Saydam	*	
J. Cochrane		*						
H. Sidgier	*							
P.L. Spencer	*							
El Cezeri	*							
S. Morse	*							
L. Laennec	*							
Thimonnier	*							
L. Biro	*							
F. Carlson	*							
C. Röntgen	*							
H. Seely	*							
Total	17	1	6	6	-	8	7	1

When Table 4 is examined, the gender status of the majority of scientists in the Science, Technology and Society unit is male (f=30; %=94); it is seen that few of them are women (f=2; %=6%).

When the resulting findings are evaluated as a whole; it has been determined that there is a great deal of agreement (overlap) between the opinions of the students and the related unit in terms of the gender status of the scientists. In this sense, both in the drawings of the students and in the related unit, it is seen that the scientists are mostly male.

**2. Appearance:**

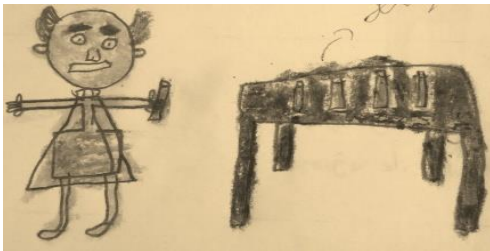
**a) Physical appearance of scientists according to students**

The students' opinions on the physical appearance of scientists are presented in Table 5.

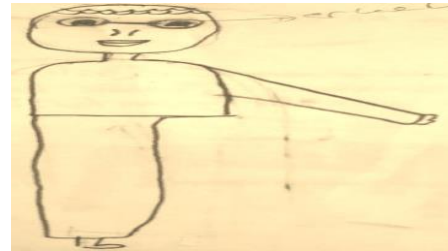
**Table 5.** Physical Appearance of Scientists according to Students

Participant	Physical appearance of scientists										
	Glasses	Lab. coat	Hairstyle				Beard shape			Bodily integrity	
			Long	Spiky	Bald	Straight	Moustache	Round	Full	Non-disabled	Disability
Abdi				*							*
Abdülatif		*			*						*
Bekir	*					*					*
Berkut	*					*		*			*
Berrin	*		*								*
Ceren			*								*
Ece			*								*
Gonca			*								*
Halit		*				*					*
Hami	*				*						*
Hasan		*	*						*		*
İpek	*	*		*							*
İsmail		*				*		*			*
İsmet	*								*		*
Kerime	*			*							*
Mehmet		*			*				*		*
Melda	*	*			*						*
Menşure	*				*						*
Müslüm											*
Narin	*	*	*								*
Niran	*					*					*
Özlem	*					*					*
Sefa				*							*
Selin	*		*								*
Suna	*				*						*
Yasemin				*							*
Yasin	*			*							*
Total	15	8	7	6	6	6	2	2	1	26	1

The most typical and atypical drawings for the appearance of scientists are presented in Figures 4 and 5.



**Figure 4.** Abdülatif's drawing



**Figure 5.** Menşure's drawing

When Figure 4 is examined, although the student codenamed Abdülatif draws the scientist as “male, in a lab coat, bald, using test tubes indoors and having bodily integrity”; when Figure 5 is examined, it is seen that the student codenamed Menşure draws the scientist as “who does not use any tools, whose hair type is not exactly clear, and who is disabled because he does not have one leg”.

**b) The physical appearances of the scientists in the Science, Technology and Society unit**

The physical appearances of the scientists in the Science, Technology and Society unit are presented in Table 6.



**Table 6.** Physical Appearances of Scientists in the Science, Technology and Society Unit

Scientist	Physical appearance								
	Glasses	Lab coat	Hairstyle			Beard shape		Bodily integrity	
			Short	Long	Bald	Full	Moustache	Non-disabled	Disability
Bell			*				*		*
Benz					*			*	*
Edison			*						*
Marconi			*						*
Baird	*		*						*
Conte					*				*
Wright's	-	-	-	-	-	-	-	-	-
Cochrane	*			*					*
Sidgier	-	-	-	-	-	-	-	-	-
Spencer			*						*
El Cezeri							*		*
Morse				*			*		*
Laennec			*						*
Thimonnier	-	-	-	-	-	-	-	-	-
Biro	-	-	-	-	-	-	-	-	-
Carlson	*		*						*
Röntgen			*				*		*
Seely	-	-	-	-	-	-	-	-	-
Einstein			*				*		*
Newton				*					*
Sancar	*	*	*						*
Arf			*						*
Halaçoğlu	-	-	-	-	-	-	-	-	-
Turan	*		*						*
Behçet	-	-	-	-	-	-	-	-	-
Yaşargil	*		*						*
Gökdoğan	*			*					*
Saydam	-	-	-	-	-	-	-	-	-
Total	7	1	13	4	2	4	2	19	1

When Table 6 is examined, it is seen that the physical appearances of scientists are typically depicted as “with glasses, hair style: short, beard style: full, body integrity: non-disabled.”

When the resulting findings are evaluated as a whole; it has been determined that there is a great deal of agreement (overlap) between the students' opinions and the relevant unit in terms of the physical appearance of the scientists.

### 3. Personal Characteristics:

#### a) Personal characteristics of scientists according to students

The students' opinions on the personal characteristics of scientists are presented in Table 7. When Table 7 is examined, it is seen that the majority of the students refer to the discovery (invention) feature of scientists. For example, a student codenamed Gonca stated the following on this subject: “Scientists are like a brain cube. A brand new invention is the person who makes an invention. For example, Thomas Edison. He is the first person to find the light bulb. In other words, a person who reveals something new when nothing is out of sight is called a 'scientist'”

Student codenamed Hasan also stated that scientists have a character that does not give up in addition to their ability to make discoveries. Hasan's opinions on this subject are as follows: “Scientists are known for their inventions over time. Giving up is not in their character traits. They bring to life things that have not been done before.” A student codenamed Kerime, on the other hand, approached the subject more holistically and tried to

express that scientists are people who benefit society with the following words: “*Scientists find -new- inventions to make life easier for people who invent new things related to science and deal with making people's lives easier.*” Some of the students, on the other hand, are making sentences with expressions such as “*scientists are intellegent and clever*”; some tried to describe the characteristics of scientists with adjectives such as “*patient, hardworking, brave, honest, and instructive*”. A student codenamed İsmet tried to draw attention to the versatile characteristics of scientists by showing a scientist as a witness as follows: “*When I think of scientists, the first person that comes to mind is Albert Einstein. Because all scientists are successful, determined and decisive. But since Einstein was more determined, decisive, and successful than them, the word scientist comes to mind as ‘success, determination and organize.’*”

**Table 7.** Personal Characteristics of Scientists according to Students

Participant	Personal characteristics of scientists													
	Inventory	Non-giving up	Useful member of society	Intelligent	Clever	Patient	Organized	Hardworking	Successful	Brave	Honest	Instructive	Determined	Decisive
Abdi	*													
Abdülatif		*		*		*								
Bekir		*				*								
Berkut														
Berrin				*										
Ceren					*		*							
Ece					*									
Gonca	*				*									
Halit			*											
Hami				*		*								
Hasan	*	*												
İpek	*													
İsmail	*													
İsmet							*		*			*	*	
Kerime	*	*	*											
Mehmet												*		
Melda								*						
Menşure			*											
Müslüm				*				*						
Narin	*													
Niran	*	*	*											
Özlem										*				
Sefa														
Selin	*		*					*						
Suna														
Yasemin														
Yasin											*			
Total	9	5	5	4	3	3	2	2	2	1	1	1	1	1

**b) Personal characteristics of scientists in the Science, Technology and Society unit**

The personal characteristics of the scientists in the Science, Technology and Society unit are presented in Table 8. When Table 8 is examined, it is seen that similar evaluations are made in the Science, Technology and Society unit regarding the personal characteristics of scientists regardless of their grade level. In addition, from the information in Table 8, it is deduced that more characteristics of scientists are mentioned in the 5th grade Science, Technology and Society unit.

**Table 8.** Personal Characteristics of Scientists in the Science, Technology and Society Unit

Characteristic	Science, Technology and Society unit		
	4 <sup>th</sup> grade	5 <sup>th</sup> grade	6 <sup>th</sup> grade
Serving humanity	*		
Hardworking	*	*	
Patient	*	*	
Researcher		*	
Curious		*	
Interrogator		*	
Have the imagination		*	*
Intelligent		*	
Suspicious		*	
Decisive		*	
Open to criticism		*	
Planned		*	
Objective		*	
Creative		*	
Non-giving up		*	
Honest		*	

When the resulting findings are evaluated as a whole; in terms of the characteristics of the scientists, it has been determined that there is a congruence (overlap) between the students' opinions and the relevant unit in some respects. In this sense:

- It has been determined that features such as “non-giving up, useful member of society (serving humanity), intelligent, patient, hardworking, honest, and decisive” are common.
- It is seen that features such as “inventory, clever, organized, successful, brave, instructive, and determined” are only included in student opinions.
- It has been determined that features such as “researcher, curious, interrogator, have the imagination, suspicious, open to criticism, planned, objective, and creative” are only included in the relevant unit.
- On the other hand, the explorer feature in the students' opinions is not of the scientists; it has been determined that the inventors are included in the 4<sup>th</sup> and 5<sup>th</sup> grades Science, Technology and Society unit as a common feature.

#### 4. Working Preferences:

##### a) Work preferences of scientists according to students

The students' opinions on the work preferences of scientists are presented in Table 9.

**Table 9.** Work Preferences of Scientists according to Students

Participant	Work preferences of scientists		Participant	Work preferences of scientists	
	Alone	Someone		Alone	Someone
Abdi	*		Kerime	*	
Abdülatif	*		Mehmet	*	
Bekir	*		Melda	*	
Berkut	*		Menşure	*	
Berrin	*		Müslüm	*	
Ceren	*		Narin	*	
Ece	*		Niran	*	
Gonca	*		Özlem	*	
Halit	*		Sefa	*	
Hami	*		Selin	*	
Hasan	*		Suna	*	
İpek	*		Yasemin		*
İsmail	*		Yasin	*	
İsmet	*				
			<b>Total (27)</b>	<b>26 (%96)</b>	<b>1 (%4)</b>

Some illustrations showing the work preferences of scientists are presented in Figures 6 and 7.

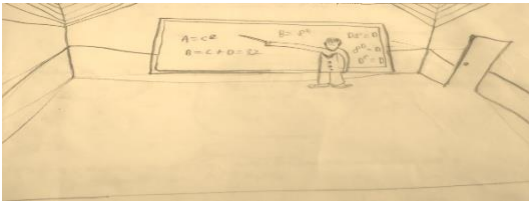


Figure 6. Halit's drawing



Figure 7. Yasemin's drawing

When Figure 6 is examined, the scientist the student codenamed Halit is alone; when Figure 7 was examined, it was determined that the student codenamed Yasemin drew the scientist as the person/s who preferred to work with the someone. It is seen that the student codenamed Yasemin describes scientists as people working together in the same environment.

### b) Work preferences of scientists in Science, Technology and Society unit

The work preferences of scientists in the Science, Technology and Society unit are presented in Table 10. When Table 10 is examined, it is shown that the majority of scientists in the Science, Technology and Society unit are in accordance with their alone (individual) work preferences (f=24; %75); it is seen that few of them do not describe their working preferences (f=8; %=25).

Table 10. Work Preferences of Scientists in Science, Technology and Society Unit

4 <sup>th</sup> grade			5 <sup>th</sup> grade			6 <sup>th</sup> grade		
Scientist	Work preference		Scientist	Work preference		Scientist	Work preference	
	Alone	Someone		Alone	Someone		Alone	Someone
G. Bell	*		G. Bell	*		Halaçoğlu	-	-
C.F. Benz	*		Einstein	*		A. Einstein	-	-
Edison	*		Edison	*		O. Turan	*	
G. Marconi	*		Newton	*		H. Behçet	-	-
J.L. Baird	*		Sancar	*		Sancar	*	
N. Conte	*		Arf	*		G. Yaşargil	*	
Wright brothers	*					Gökdoğan	*	
J. Cochrane	*					R. Saydam	-	-
H. Sidgier	-	-						
P. Spencer	*							
El Cezeri	*							
S. Morse	*							
L. Laennec	*							
Thimonnier	-	-						
L. Biro	-	-						
F. Carlson	*							
C. Röntgen	*							
H. Seely	-	-						
Total	14	-		6	-		4	-

When the resulting findings are evaluated as a whole; it has been determined that there is a great deal of agreement (overlap) between the students' opinions and the relevant unit in terms of the work preferences of the scientists. In this sense, it is seen that the alone study preferences of scientists come to the fore both in the opinions of the students and in the related unit.

## 5. Study Areas:

### a) Study areas of scientists according to students

The students' opinions on the areas of study of scientists are presented in Table 11.

**Table 11.** Areas of Study of Scientists according to Students

Participants	Areas of study of scientists									
	Science and Mathematics					Social Sciences				
	Chemistry	Astronomy	Physics	Medicine	Math	Techn ology	Geography	History	Sociology	Philosophy
Abdi						*				
Abdülatif										
Bekir										
Berkut	*					*	*	*		
Berrin		*					*	*		
Ceren	*									
Ece		*								
Gonca			*							
Halit										
Hami		*		*		*				
Hasan										
İpek	*		*				*	*	*	
İsmail		*		*						
İsmet										
Kerime				*						
Mehmet				*						
Melda						*				
Menşüre							*	*	*	*
Müslüm	*		*							
Narin	*		*				*	*	*	*
Niran	*		*							
Özlem		*								
Sefa	*		*							
Selin										
Suna		*								
Yasemin		*								
Yasin				*						
Total	7	7	6	4	1	3	5	5	3	2

When Table 11 is examined, it is seen that most of the students think of scientists as people working in the areas of Science and Mathematics. As an example, the opinions of a student codenamed Sefa can be given: *“The person who deals with science is called a scientist. Scientist deals with experiment and science.”* On the other hand, a small number of students claimed that scientists study in social sciences. In this regard, the student codenamed Menşüre stated the following: *“Scientists; they deal with Philosophy, Geography, History, and Sociology.”* Some students stated that scientists study in both Science-Mathematics and social science areas. An example of this is the opinions of a student codenamed İpek: *“Scientist; History, culture, Geography, Physics, Chemistry etc. deals with issues. Conducts experiments on these topics. They try to prove their claims by studying in these areas.”* Along with these, a student codenamed Melda stated that scientists deal with technology as follows: *“Scientists deal with technology.”*

**b) Study areas of scientists in the Science, Technology and Society unit**

The study areas of the scientists in the Science, Technology and Society unit are presented in Table 12. When Table 12 is examined, it is seen that scientists are mostly in technology (f=18; %=50%) and Science-Mathematics sciences (f=16; %=44); it is seen that very few of them carry out studies in social sciences (f=2; %=6).

When the resulting findings are evaluated as a whole; in terms of the areas of study of scientists, there is some agreement (in the context of Science and Mathematics) between student opinions and the relevant unit; it has been determined that there is a difference in some aspects (in the context of technology and social science).

**Table 12.** Study Areas of Scientists in the Unit of Science, Technology and Society

Scientist	Study area						
	Science and Mathematics					Technology	Social Science History
	Medicine	Physics	Math	Chemistry	Astronomy		
Bell						*	
Benz						*	
Edison						*	
Marconi		*				*	
Baird						*	
Conte				*		*	
Wright's						*	
Cochrane						*	
Sidgier						*	
Spencer						*	
El Cezeri						*	
Morse						*	
Laennec	*					*	
Thimonnier						*	
Biro						*	
Carlson						*	
Röntgen		*				*	
Seely						*	
Einstein		*					
Newton		*	*		*		
Sancar	*			*			
Arf			*				
Halaçoğlu							*
Turan							*
Behçet	*						
Yaşargil	*						
Gökdoğan			*		*		
Saydam	*						
Total	5	4	3	2	2	18	2

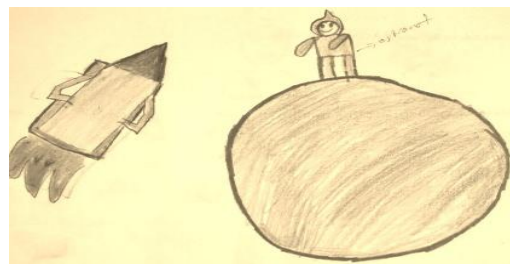
**6. Working Places:**

**a) Working places of scientists according to students**

The opinions of the students about the working places of the scientists are presented in Table 13. Some drawings indicating the working places of the scientists are presented in Figures 8 and 9.



**Figure 8.** Hasan's drawing



**Figure 9.** Müslüm's drawing

When Figure 8 is examined, the scientist of the student codenamed Hasan is indoors; when Figure 9 was examined, it was determined that the student codenamed Müslüm drew the scientist as a person working in an open space. It is seen that the student codenamed Müslüm describes the scientist as a person who deals with

Astronomy. On the contrary, a student codenamed Hasan drew the scientist on a desk figure with instructional tools such as a book and pencil and while thinking about the space shuttle.

**Table 13.** Working Places of Scientists according to Students

Participant	Working places of scientists		Participant	Working places of scientists	
	Indoors	Open		Indoors	Open
Abdi	*		Kerime	*	
Abdülatif	*		Mehmet	*	
Bekir	*		Melda	*	
Berkut	*		Menşure	*	
Berrin	*		Müslüm		*
Ceren	*		Narin	*	
Ece	*		Niran	*	
Gonca	*		Özlem	*	
Halit	*		Sefa	*	
Hami		*	Selin	*	
Hasan	*		Suna	*	
İpek	*		Yasemin		*
İsmail	*		Yasin	*	
İsmet	*		Total (27)	24 (%88)	3 (%12)

**b) Working places of scientists in the Science, Technology and Society unit**

The working places of the scientists in the Science, Technology and Society unit are presented in Table 14.

**Table 14.** Working Places of Scientists in the Science, Technology and Society Unit

Scientist	4 <sup>th</sup> grade		Scientist	5 <sup>th</sup> grade		Scientist	6 <sup>th</sup> grade	
	Working place			Working place			Working place	
	Open	Indoor		Open	Indoor		Open	Indoor
A.G. Bell		*	A.G. Bell		*	Y. Halaçoğlu	-	-
C.F. Benz		*	A. Einstein		*	A. Einstein	-	-
T. Edison		*	T. Edison		*	Osman Turan		*
G. Marconi		*	I. Newton		*	Hulusi Behçet	-	-
J.L. Baird		*	A. Sancar		*	Aziz Sancar		*
N. Conte		*	Cahit Arf		*	Gazi Yaşargil		*
Wright brothers	*					N. Gökdoğan		*
J. Cochrane		*				Refik Saydam	-	-
H. Sidgier	-	-						
P. Spencer		*						
El Cezeri	*							
S. Morse		*						
L. Laennec		*						
Thimonnier	-	-						
L. Biro	-	-						
F. Carlson		*						
C. Röntgen		*						
H. Seely	-	-						
Total	2	12		-	6		-	4

When Table 14 is examined; the majority of the scientists in the Science, Technology and Society unit carry out studies in indoor places (f=22;=69%); it is seen that few of them either carry out works in open places (f=2; %=6) or the working spaces are not described (f=8; %=25).

When the resulting findings are evaluated as a whole; It has been determined that there is a great deal of

agreement (overlap) between the opinions of the students and the related unit in terms of the working places of the scientists. In this sense, both in the opinions of the students and in the related unit, it comes to the fore that scientists have a preference for indoor work.

## 7. Tools and Equipment:

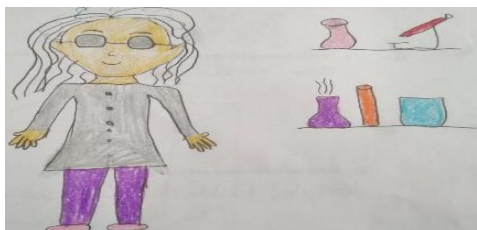
### a) According to the students, the tools and equipment used by the scientists

The students' opinions on the tools and equipment used by the scientists are presented in Table 15.

**Table 15.** Tools Used by Scientists according to Students

Participants	Tools used by scientists					
	Test tube	Pencil	Book	Blackboard	Stethoscope	Spacecraft
Abdi	*					
Abdülatif	*					
Bekir						
Berkut						
Berrin	*					
Ceren						
Ece	*					
Gonca						
Halit				*		
Hami	*					
Hasan		*	*			
İpek						
İsmail						
İsmet						
Kerime		*				
Mehmet						
Melda						
Menşure						
Müslüm						*
Narin	*					
Niran		*				
Özlem					*	
Sefa	*					
Selin						
Suna						
Yasemin						
Yasin						
Total	7 (%50)	3 (%21)	1 (%7)	1 (%7)	1 (%7)	1 (%7)

Some drawings showing the tools and equipment used by scientists are presented in Figures 10 and 11.



**Figure 10.** Narin's drawing



**Figure 11.** Özlem's drawing

When Figure 10 is examined, test tubes representing the tools and equipment used by the scientist of the student codenamed Narin; when Figure 11 is examined, it is seen that the student codenamed Özlem draws a stethoscope hanging around her neck.



### b) Tools and equipment used by scientists in the Science, Technology and Society unit

The tools and equipment used by the scientists in the Science, Technology and Society unit are presented in Table 16. When Table 16 is examined; it has been determined that there are texts and visuals indicating that scientists use very few tools in the Science, Technology and Society unit.

**Table 16.** Tools and Equipment Used by Scientists in the Science, Technology and Society Unit

	Scientist	Tools and equipment			
		Test tube	Book	Fountain	Hose
4 <sup>th</sup> grade	A.G. Bell				
	C.F. Benz				
	T.A. Edison				
	G. Marconi				
	J.L. Baird				
	N. Conte				
	Wright's				
	J. Cochrane			*	*
	H. Sidgier				
	P.L. Spencer				
	El Cezeri				
	S. Morse				
	L. Laennec				
	Thimonnier				
L. Biro					
F. Carlson					
C. Röntgen					
H. Seely					
Total			1	1	
5 <sup>th</sup> grade	A.G. Bell				
	A. Einstein				
	T.A. Edison				
	I. Newton		*		
	Aziz Sancar	*			
	Cahit Arf				
	Total	1	1		
6 <sup>th</sup> grade	Y. Halaçoğlu				
	A. Einstein				
	Osman Turan				
	Hulusi Behçet				
	Aziz Sancar				
	Gazi Yaşargil				
	N. Gökdoğan				
Refik Saydam					
Total					
	Grand total	1	1	1	1

When the resulting findings are evaluated as a whole; it has been determined that there is a great deal of agreement (overlap) between the students' opinions and the relevant unit in terms of the tools and equipment used by the scientists. In this sense, both in the students' opinions and in the related unit, scientists' use of test tubes and books comes to the fore.

### Discussion & Conclusion

It has been concluded that the opinions and images of the students towards the scientist and the profile of the scientist in the Science, Technology and Society unit largely overlap. In this sense, "gender status (male), working preference (alone), working place (indoor), equipment (test tube and book), appearance (glasses, short or

bald hair style, full beard style, body integrity: non-disabled) and study area (Science-Mathematics)", it was concluded that there is a concordance in terms of cases such as. On the other hand, it can be said that there is a partial agreement in terms of "personal characteristics".

It was concluded that the majority of the students had similar stereotypical opinions and images about the scientist. For example, according to most of the students in this study, scientists were portrayed as men in science-mathematics areas study alone indoors with test tubes, wearing lab coats, and glasses. This shows that the image about the scientist that emerged as a result of previous studies and the stereotypical images that emerged as a result of this research are similar (Doğan, 2015; Emvalotis & Koutsianou, 2018; Farland et al., 2012; Kara & Akarsu, 2013; Küçük & Bağ, 2012; Özdemir & Ünal, 2020; Özsoy & Ahi, 2014). A similar trend was also detected in the textbooks examined. In addition, in this research, it is seen that female students draw both male and female scientists. On the other hand, it is striking that male students tend to draw male scientists. In some studies conducted, research results supporting the existence of this stereotypical situation have been reported (Narayan et al., 2013; Song & Kim, 2010). Some differences in stereotypes according to gender are that stereotypes are not just from individuals or from textbooks; also social; in other words, it also suggests that it is a cultural phenomenon (Cheryan, Master & Meltzoff, 2015; Marcus & Zajonc, 1985).

However, considering the scientist images that students adopt, it is an unexpected finding that students portray the scientist as "the discoverer and explorer". Moreover, it is seen that the differences between scientists and explorers in the Science, Technology and Society unit of social studies textbooks that students are exposed to are emphasized. Considering that science in Turkey is most typically taught through course-based instruction based on textbook knowledge, it is interesting that students describe scientists as "explorers". A scientist's lack of understanding and clarity about what he really is gives rise to myths like "science is boring" or "science is only for intelligent people" and is often a deterrent to further reading of science (Archer et al., 2012; Narayan et al., 2013). In parallel with this, as a result of this research; it has been revealed that scientists are intelligent and clever people both in the relevant unit and in the opinions of the students.

An interesting result of the research is that most of the scientists in the examined unit were selected from individuals working in science-mathematics and medicine. However, the Social Studies course is a very broad course that is taught in primary school (4<sup>th</sup> grade) and secondary schools (5, 6, and 7<sup>th</sup> grades) by bringing together different social science branches, and its scope and accordingly its aims. In order to realize these aims, History, Geography, Citizenship, Anthropology, Sociology, Psychology, Economics, Archeology etc. the content is highly diversified with social disciplines. In this sense, it is thought-provoking that very little space is reserved for scientists study in the area of social sciences in social studies textbooks. Therefore, it can be said that this implicit message creates an organizing mental set for students to perceive areas such as science-mathematics, and medicine when it comes to scientist and scientific study. Moreover, when the opinions and images of the students are examined, it is seen that this mental set has already been formed.

Although this comparison study was based on sound research methods, it must be recognized that the findings of this study cannot be generalized due to the relatively small sample size. In addition, students' opinions and images of scientists were tried to be learned through open-ended questionnaires and drawings; on the other hand, the scientist profile in the textbooks is limited to the learning area of Science, Technology and Society. In this context, based on the limitations and results of the research; several critical considerations can be made for research. First of all, it is thought that there is a tendency towards misconceptions in students' opinions of scientists. Second, it can be said that textbooks have a shaping effect on students' opinions and images of scientists. Finally, it can be argued that female students try to describe scientists with stereotypical generalizations to a lesser extent than male students.

Based on the findings of the study, the following are recommended:

- ✓ Social Studies textbooks should include scientists study in the area of social science as well as scientists study in the area of science, mathematics / medicine in the learning area of "Science, Technology and Society".
- ✓ In order to shape students' perceptions of scientists at the right point and to guide textbook authors, the "Science, Technology and Society" learning area should be included in the explanations of the relevant acquisitions (scientists and scientists' studies), taking into account the scientific definition of scientist.
- ✓ Since it has been determined that students have a tendency towards misconceptions about the personal and physical characteristics of the scientist, social studies teachers should ensure that students perceive scientists correctly through concept teaching principles, methods, techniques, and tools.

- ✓ In the "Science, Technology and Society" unit in social studies textbooks, scientists; should be portrayed as individuals working in open places in accordance with cooperation skills and solidarity values.
- ✓ It is recommended that research and studies be carried out to reveal the factors that affect the stereotype generalizations of male students about scientists.

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# SOSYAL BİLGİLER ÖĞRETİMİNDE BİLİM İNSANLARININ ÖZELLİKLERİNE İLİŞKİN KARŞILAŞTIRMALI BİR İNCELEME

Sezgin ELBAY

## ÖZ

Bu araştırma birbirinden bağımsız gibi görünen 2 durumu karşılaştırmak amacıyla yürütülmüştür. Bu çerçevede araştırmada, Ortaokul 6. sınıf öğrencilerinin bilim insanına yönelik görüş ve imajları ile öğrencilerin şu ana kadar maruz kaldıkları sosyal bilgiler ders kitapları (4, 5 ve 6. sınıf) Bilim, Teknoloji ve Toplum ünitesindeki bilim insanı profili karşılaştırılmıştır. Bu nedenle araştırma, doküman analizi ve bütüncül tek durum çalışma yöntemine göre yürütülmüştür. Araştırmanın çalışma grubunu, ölçüt durum örnekleme yöntemine göre belirlenen yaşları 11-12 arasında değişen 27 öğrenci (kadın=14, %52; erkek=13, %48); ayrıca sosyal bilgiler ders kitapları (4, 5 ve 6. sınıf) Bilim, Teknoloji ve Toplum ünitesi oluşturmuştur. Veriler; açık uçlu anket, çizim ve bilim insanı belirleme formları aracılığıyla toplanmıştır. Elde edilen veriler üzerinde doküman ve betimsel analiz yapılmıştır. Analiz sonucunda, öğrencilerin bilim insanına yönelik görüş ve imajları ile Bilim, Teknoloji ve Toplum ünitesinde yer alan bilim insanı profilinin büyük oranda örtüştüğü sonucuna ulaşılmıştır. Ulaşılan bu sonuçlar doğrultusunda Sosyal Bilgiler ders kitaplarında "Bilim, Teknoloji ve Toplum" öğrenme alanında fen, matematik/tıp alanında çalışan bilim insanlarının yanı sıra sosyal bilimler alanında çalışan bilim insanlarına da yer verilmesi önerilmektedir.

**Anahtar Kelimeler:** Sosyal bilgiler öğretimi, bilim, teknoloji ve toplum öğrenme alanı, bilim insanlarının özellikleri