EVALUATION OF IMAGES OF SECONDARY SCHOOL STUDENTS FOR SCIENTISTS' GENDERS ACCORDING TO TOULMIN'S ARGUMENTATION MODEL COMPONENTS

ORTAOKUL ÖĞRENCİLERİNİN SAHİP OLDUKLARI BİLİM İNSANI CİNSİYETİNE YÖNELİK İMAJLARININ TOULMİN'İN ARGÜMANTASYON MODELİ BİLEŞENLERİNE GÖRE DEĞERLENDİRİLMESİ

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ABSTRACT

The purpose of this study is to examine and evaluate the reasons of secondary school students' images for the gender of scientists according to the Argumentation Model components of Toulmin. The research was made using the case study method, which is a qualitative research method. The research was carried out in a secondary school in Düzce province in the 2019-2020 academic years. 64 8th grade students participated in the study. In the research "Draw-A-Scientist-Test (DAST)" and semi-structured interview forms were used as data collection tools. Descriptive analysis and content analysis methods were used to analyze the data. As the result of the research, it is observed that the scientists' image in students' minds is predominantly male. The students explain the main reasons for having such a stereotypical image on scientists' genders as their personal observations, visual media, printed sources and popular scientists. On the other hand, it is also observed that scientist' image in some students' mind is female and these students explain this situation as a reaction to the visual media, printed sources and traditional gender stereotypes. Considering these reasons, it is thought that posts shared on these sources concerning scientists can be revised and the stereotyped scientist images that may occur in the students can be prevented.

Keywords: Toulmin's argumantation model; scientist's image; scientist's gender.

ÖZ

Bu araştırmanın amacı ortaokul öğrencilerinin bilim insanlarının cinsiyetine yönelik sahip oldukları imajların nedenlerini Toulmin'in Argümantasyon Modeli bileşenlerine göre irdelenmesi ve değerlendirilmesidir. Araştırmada nitel araştırma yöntemlerinden durum çalışması kullanılmıştır. Araştırma 2019-2020 öğretim yılında Düzce ilinde bir orta okul kurumunda yürütülmüştür. Araştırmanın katılımcıları 64 sekizinci sınıf öğrencisidir. Araştırmada veri toplama aracı olarak bilim insanı çiz testi (DAST) ile yarı yapılandırılmış görüşme formları kullanılmıştır. Verilerin analizinde betimsel analiz ve içerik analizi yöntemi kullanılmıştır. Araştırma sonucunda, öğrencilerin bilim insanı cinsiyetine dair imajlarının erkek olduğu bulunmuştur. Bu bilim insanının cinsiyetine yönelik basmakalıp bilim insanı imajına sahip olma nedenlerini ise çevresinde gördükleri, görsel medya, yazılı kaynaklar ve popüler bilim insanları olarak açıklamışlardır. Araştırmaya katılan bir kısım öğrencinin ise bilim insanı cinsiyetine dair imajların kadın olduğu sonucuna ulaşılmış, öğrenciler bu durumun nedenlerini, görsel medya, yazılı kaynaklar ve gelenekselleşmiş cinsiyet kalıplarına tepki olarak açıklamışlardır. Bu nedenler göz önüne alınarak, bu kaynaklarda yer alan bilim insanlarına dair paylaşımların yeniden gözden geçirilip öğrencilerde oluşabilecek basmakalıp bilim insanı imajlarının önüne geçilebileceği düşünülmektedir.

Anahtar Kelimeler: Toulmin'in argümantasyon modeli; bilim insanı imajı; bilim insanı cinsiyeti.

INTRODUCTION

Image is defined as the impressions, attitudes, carriages, manners related behaviors and beliefs that individuals have about individuals, institutions or organizations (Lemmimk, Schuijf & Streukens, 2003) and gradually and cumulatively formed in each individual (Tolungüç, 1992). In addition, the image is one of the seven types of information elements and is defined as the pictures that appear in our minds when we hear the names of the concepts or think about them (Atasoy, 2004). The formation of correct images is also very important in learning science concepts (Devetak & Glazar, 2009; Kavak, 2007). In studies related to these science concepts, while Kurnaz and Ekşi (2015) worked on images of frictional force, Bilir, Digilli-Baran & Karaçam (2016) did the same on atomic models and Eyceyurt Türk & Tüzün (2018) on atomic orbitals. In addition to these studies, it is seen that the studies on the image of the scientists play a bigger role.

When a literature review is made on the image of the scientists, it is seen that many studies on different educational levels were made with participants (Ağgül-Yalçın, 2012; Bozdoğan, Durukan & Hacıoğlu, 2018; Buldu, 2006; Chambers, 1983; Eyceyurt-Türk & Tüzün, 2017; Farland-Smith, 2009; Finson, Beaver & Cramond, 1995; Finson, 2002; Güler & Akman, 2006; Karaçam, 2015; Karacam, 2016; Mead & Metraux, 1957; Medina-Jerez, Middleton & Orihuela-Rabaza, 2011; Oktay & Eryurt, 2012; Turgut, Öztürk & Eş, 2017; Türkmen, 2008; Ürey, Karaçöp, Göksu & Çolak, 2017). In addition to these, there are also studies on scientists working in the field of physics (Durukan & Sadoglu, 2018), chemistry (Bilir, Eyceyurt Türk & Tüzün, 2020), mathematics (Aydoğan Yenmez & Gökçe, 2020; Martin & Gourley-Delaney, 2014; Picker & Berry, 2000), and biology (Korkmaz, 2011).

Image of the Scientist

While Einstein's definition of science is "an effort to ensure compatibility between sensory data devoid of any order and logically regular thinking", English philosopher Russell defines it as "an effort to find facts about the world first and then the laws connecting these with one another through observation and observational reasoning (Bilen, 2015). Those who are engaged in scientific studies are qualified as scientists. The absence of a definite definition of science, and hence the scientist, and the fact that there is a wide range of expressions in the definitions made, raised the question of how these expressions are perceived in the society, and determining the image of the scientist has become a field within science studies.

Research conducted by Mead and Metraux (1957) is one of the first studies made on the scientists' image. Researchers asked 35.000 students from 132 state and 13 private high schools in the United States to complete 9 incomplete sentences with their own words in a way that each sentence will form a paragraph. The study showed that the stereotypical scientists' image is an old, short, bearded, humped, exhausted looking man in glasses. These expressions are what comprises the stereotypical scientist image. Chambers (1983) used the "Draw-A-Scientist-Test (DAST), which he developed and claims to be more successful in defining attitudes especially in younger age groups, in his study and reached similar conclusions with Mead and Metraux (1957).

Although DAST and its markers, developed by Chambers (1983), have been used to reveal the scientist images of individuals, Finson, Beaver and Cramond (1995) developed the Draw-A-Scientist-Checklist (DAST-C) for easier analysis of individuals' drawings. The indicators on their Draw-A-Scientist-Checklis (DAST-C) are as follows;

1- Lab Coat

2- Eyeglasses

3- Moustache, beard, etc.

4- Laboratory equipment

5- Books, pens, boards, etc.

6- Technologic tools,

7- Formulas, mind maps, etc.

8- Male gender scientist only

9- Middle-aged or elderly individuals

10- Superheroes, androids, robots, etc. Mythic creatures

11- Warning signs (Caution!, No Entry!, Top Secret!, Secret!, Fragile!, etc.

12- Scientist(s) working indoors

DAST, developed by Chambers (1983), is very useful to use in different language groups without any significant translation problems, since there is no need for verbal or written answers. This is an advantage that made the method being preferred by researchers from many different countries. Along with the use of DAST frequently in the field, it was claimed their new image patters could be added to the 12 indicators of scientists' image in the DAST-C scale, Karaçam, Bilir & Digilli-Baran (2018) suggested in their study carried out with 220 prospective teachers in which they examine the prospective teachers' drawings on the scientists' image that trash and trash bin could also be categorized as one of the stereotyped scientist image indicators (see Figure 1).

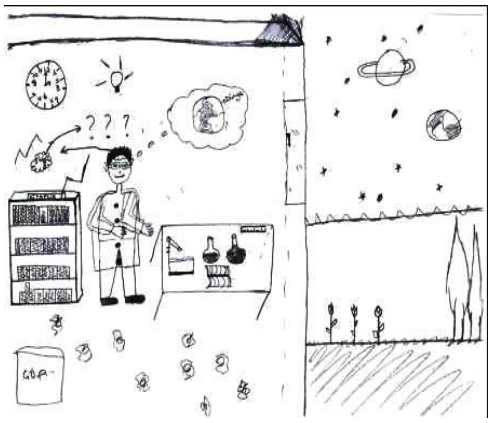

Figure 1. An example of a scientist drawing (Karaçam, Bilir & Digilli-Baran, 2018)

The scientists' images in the students' mind bear a complicated structure and is are influenced by various sources such as school, books, teacher practices, gender, extracurricular activities, television and science fiction novels. Gheith and Aljaberi (2019) have revealed that sources of the scientists' image in prospective teachers' and pedagogical teachers' minds are the internet, science stories, academic texts and teachers. In a study where the scientists' images in 1011 secondary school students' minds are examined, it is seen that the source for these images are memoirs of scientists, the internet, textbooks, science magazines and movies (Bozdoğan et al., 2018). Using a questionnaire consisting of open-ended questions and a semi-structured interview form, Karaçam and Digilli Baran (2017) revealed that secondary school students' source that they are influenced about the scientists' image in their mind is the students' cultural backgrounds, scientist figures represented in printed or visual media and the community's use of the concept of "scientist" for defining experts in fields of science. In the research examining the factors that influence the scientists' image concerning their gender in the minds of secondary school female students', it is observed that while the sources for the female students bearing the male image in their minds are particularly visual media and printed sources, the sources for the ones bearing the female scientist image in their minds are the reactions against traditional gender patterns and desire to become a scientist in the future (Özdeş & Aslan, 2019).

Argumentation and Toulmin's Argumentation Model

The main purpose of science education given in schools is to allow students to participate in social discussions and use science's perception in making balanced and conscious decisions about social issues affecting their lives (Sadler & Zeidler, 2005). This purpose requires classroom environments in which the students discuss the benefit-loss relationship towards scientific facts so that they can express their opinions comfortably, support their thoughts for different reasons, and develop contradictory arguments to refute their friends' claims. As a result of this, the importance of argumentation-supported teaching in science education becomes apparent, and argumentation is defined as the way of scientific thinking as a social activity, which we can express as scientific discussion (Kuhn, 2009).

Scientists introduced various models related to argumentation. Toulmin (2003) defined a detailed model for the argument and revealed that there are three main elements in an argument in his model. These are ground, claim and qualifiers which serve as a bridge to reach the conclusion from the ground (Toulmin, 2003). Three additional components, namely qualifier, rebuttal and promoter, can be added to this structure. In detail, these additional components are the warrants or backings that reinforce the qualifiers and the rebuttal that shows the claim's validity (Balcı, 2015). While the argument contributes to its content with components such as data, claim, rationale and promoter, the process created by combining these components is called argumentation (Simon, Erduran & Osborne, 2006).

Many researchers have used Toulmin's argumentation model as an analysis framework. (Cetin, 2014; Chen et al., 2016; Mendonça & Justi, 2014). In their study in which they examine high school chemistry class achievements in Turkey according to the elements of Toulmin's argumentation model, Tüzün, Bilir and Eyceyurt-Türk (2019) have reached the conclusion that high school chemistry class curriculum achievements are moderately favorable for argument structuring as per Toulmin's argumentation model. In the study in which the problem solving processes of prospective teachers are analyzed using Toulmin's Argumentation Model, it was observed that the most frequently used element was the "claim". In a study conducted by Oh (2014), prospective science teachers investigated alternative concepts and their origins according to the components of Toulmin's Argumentation Model.

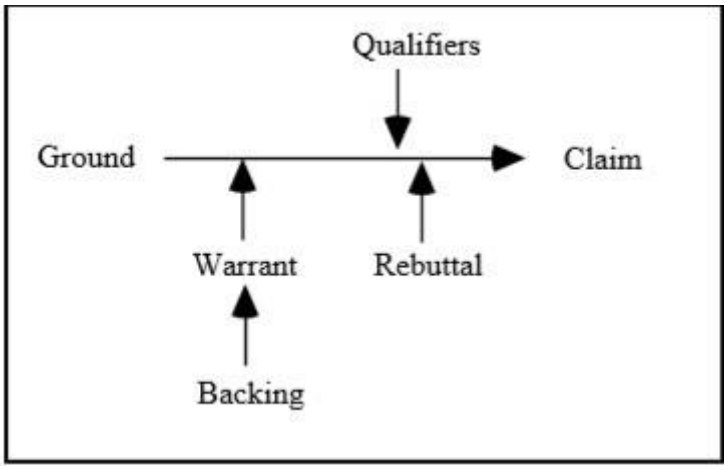

Figure 2. Toulmin's argumentation model (Dalianis & Johannesson, 1998)

In a research where it is thought that argumentation might play an effective role in the handling of complex sociological issue, a discussion environment was adapted in accordance with the components of Toulmin's Argumentation Model to analyze prospective teachers' understanding of basic concepts of global climate change and it is observed to be an effective strategy to improve prospective teachers understanding and perception on global climate change (Lambert & Bleicher, 2017).

Purpose of the Study

When the literature is reviewed, it can be seen that many studies are made on different levels of education such as pre-school (Güler & Akman, 2006; Çakıcı, 2018), primary school (Baday, 2019; Bayram, 2018; Kaya, Afacan, Polat & Urtekin, 2013) secondary school (Gülhan & Şahin, 2018; Koren & Bar, 2009), high school (Eyceyurt Türk & Tüzün, 2017) and even college (Çermik, 2013; Moseley & Norris, 1999; Özkan, 2016) to reveal the image of the scientist. Analyzing these studies, it is observed that even as the stereotypical scientist image gets less common as the level of education increases, still the scientists' image in students' mind is predominantly male. Özgelen (2012) discusses the effect of textbooks and experiences at school on the formation of the scientists' image. On the other hand, Özkan et al., (2017) and Steinke (2005) point out the influence of media tools such as television. However, it is noteworthy that there are not enough studies done to examine the causes of the scientists' image in students' minds.

The purpose of this study is to examine and evaluate the reasons of secondary school students' images for the gender of scientists according to the Argumentation Model components of Toulmin. This study differs from other studies in terms of evaluating the causes of the image of the scientist regarding the gender according to the components of Toulmin's Argumentation Model. In the conclusion section of the study, the reasons causing the scientists' current image concerning gender in students' minds is to be more systematically revealed. Also, it is thought that the results of this study will contribute to other studies to be made in order to change the scientists' stereotypical gender image in students' mind.

Research Question

In the study, it is aimed to reveal the scientists' gender image in secondary school students' minds and the reasons for such image. The main question of the study is given as:

What are the reasons for the scientists' gender image in the minds of secondary school students?

The following sub-research questions are sought:

1. What are the scientists' gender image in eight grade secondary school students minds?
2. What are the claims eight grade secondary school students have on scientists' genders?
3. What are the data for the students who have a male scientist image in their minds?
4. What are the data for the students who have a female scientist image in their minds?
5. What are the rationale for the students who have a male scientist image in their minds?
6. What are the rationale for the students who have a female scientist image in their minds?
7. What are the promoters for the students who have a male scientist image in their minds?
8. What are the promoters for the students who have a female scientist image in their minds?

METHOD

In this study, qualitative data collection tools are used in order to evaluation of the scientists' image regarding gender in secondary school students' minds and its reason according to the components of Tolumin's Argumentation Model. Case study, which is a qualitative research method, is preferred for the study. The key feature of the case study is that it allows the researcher to focus on facts that create subjects and cases and to explain the data obtained in depth and in detail (Çepni, 2010).

Research Group

While 71 8th grade students volunteered for the research which was conducted in the same school within the central district of Düzce. The data collection part of the research was completed with a total of 64 students, 32 male, 32 female, after the drawing and interview stages. Convenience sampling method was used for determination of the study group. Convenience sampling allows a study group that allows an easier research process to be preferred (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2016).

Research Group Data Collection Tools

During the research, the DAST (Draw-A-Scientist-Test), developed by Chambers (1983) was used to reveal the scientists' image regarding gender in secondary school students' minds. When applied, DAST requires students to draw scientists on blank papers they are handed. After that, these drawings are analyzed. At the first step, DAST was applied on the students participated by handing them blank papers and the students were asked to draw whatever comes to their mind when "a scientist" is mentioned on these blank papers. Students completed their drawings in an average of 40 minutes.

In the research a semi-structured interview form was used as a data collection tool in order to determine the reasons for the scientists' image regarding gender in the minds of 8th grade students' minds. The questions in the semi-structured interview form were prepared based on Toulmin's Argumentation Model Components, and the interview form was created by two field experts handling the adjustments required. In order to see how the questions in this semi-structured interview form work, a pilot application was made, the form was re-examined by the researchers according to the results of this application, and a semi-structured interview form was designed with a final form. Questions created for students based on the scientists' image regarding gender in the students' mind after completion of their drawings. The questions in the semi-structured interview form are given below.

1. *Is the scientist in this drawing female or male?*
2. *What are the cases you used for drawing the scientist as a male or a female?*
3. *Can you explain the reasons for drawing the scientist as a male or a female?*
4. *How can you promote your reasons for drawing the scientist as a male or a female?*

The questions in the semi-structured interview form were prepared considering the data, claim, rationale and promoter components that form Toulmin's argumentation model. The claim, which is one of the components of Toulmin's argumentation model, is defined as the thought, result or explanation proposed as a question or solution to the problem. The first question in the semi-structured interview form was prepared based on this definition. Data, another component of Toulmin's argumentation model, is defined as the fact, case study or observations used to promote the claim, and the second question in the semi-structured interview form were prepared based on this definition. The third question in the semi-structured interview form was prepared based on the definition of the rationale, once again one of Toulmin's argumentation model components. The rationale is defined as the reasons that show how the data support the claim. The last question in the semi-structured interview form is the definition of promoter, which is also one of the components of Toulmin's argumentation model, and it has been defined as the sample cases or other basic information accepted in the relevant field to increase the acceptability of the reason in some cases.

Data Collection Process

Data collection tools were used on 64 8th grade students who were volunteers and go to a secondary school in the central district of Düzce in order to reveal the scientists' image regarding gender in their minds and to determine the reasons for this. All data collection process was handled by four researchers and completed in a day. Interviews were recorded in semi-structured interview forms instead of voice recorders at the request of the students. A section from a sample registration document and a scientist's drawing is presented below.

Researcher: Is the scientist in this drawing female or male?

Student, Code S2: Male

Researcher: What are the cases you used for drawing the scientist as a male?

Student, Code S2: All the scientists I've ever heard of were male

Researcher: Can you explain the reasons for drawing the scientist as a male?

Student, Code S2: I saw it on the science textbook

Researcher: How can you promote your reasons for drawing the scientist as a male?

Student, Code S2: I drew thinking of Graham Bell and Einstein, whom I saw on my science textbook

Figure 3. Drawing of a scientist belonging to the student code S2

Data Analysis

The data obtained from DAST were analyzed only in terms of gender of the scientist in the drawing. The results of the analysis were made according to three themes, namely "male scientist", "female scientist" and "male scientists working with the group".

While the data obtained from the semi-structured observation form did not include student names due to ethical rules, students were numbered from 1 to 64, e.g. S1, S2 and evaluated by content analysis technique and frequencies were determined by creating themes, codes and categories. Content analysis can be defined as a whole set of methodological tools and techniques applied to a wide variety of discourses. These tools and techniques can be described above all as a controlled interpretation effort and generally as a deductive 'reading' tool (Bilgin, 2006). Toulmin's argumentation model components (claim, data, rationale and promoter) were determined as content analysis themes, codes for data obtained from semi-structured interview forms were created, similar codes and differences were analyzed by combining similar codes, and categories were analyzed. Qualitative research should be confirmable for better reliability (Yıldırım & Şimşek, 2013). For this reason, while the DAST scale and semi-structured interview forms of the study were stored physically, the data from the coding of the researchers were stored in a computer environment.

In order to determine the internal consistency in content analysis, one or more people should code and compare the results. For this purpose, the data of ten students randomly selected from both DAST and semi-structured interview forms were analyzed by two researchers, their codes and categories related to codes were compared, and the consistency percentage of DAST found to be 100% while the consistency percentage of the semi-structured interview form was 92% [(number of same coded items in two forms / total number of items in one form) * 100 = Percentage of consistency)] (Miles & Huberman, 1994). 70% is considered sufficient for internal consistency (Yıldırım & Şimşek, 2013).

FINDINGS

"What are the scientists' gender image in secondary school students minds?" was the first question of the research. Frequency distribution of the scientists' gender image in 8th grade secondary school students minds obtained from DAST is shown in Table 1.

Table 1.
Scientists' gender images in students' minds

	Male Students (f)	*Female Students (f)*	*Total (f)*	*Total (%)*
Male scientist	29	24	53	82.8
Female scientist	1	7	8	12.5
Male scientists working in a group	2	1	3	4.7
Total	32	32	64	100

When Table 1 is analyzed, it can be seen that both for male and female students, the scientists' gender image is predominantly male (f=53, 82.8%). This is followed by the female scientists (f = 8, 12.5%) and male scientists working with a group (f = 3, 4.7%), respectively. Below are examples of male and female scientist drawings drawn by students.

Figure 4. Drawing of a male scientist belonging to student S4

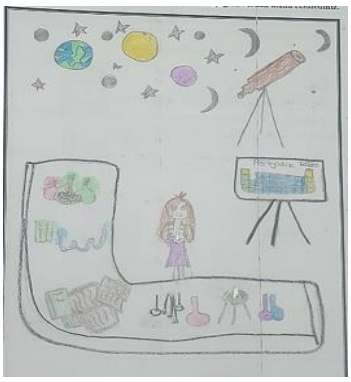

Figure 5. Drawing of a female scientist belonging to student S45

"What are the claims of scientists' gender image in secondary school students minds?" was the second question. While the first question of the semi-structured interview form intended to find the answer for this, the codes derived from the analysis of answers given to the question of "*Is the scientist in this drawing female or male?" were given below.*

Table 2.
Students opinions on the gender of the scientist

Theme	Category	Code	Frequency
Claim on Scientists' Gender	Male	The gender of the scientist I drew is male, male.	56
	Female	The gender of the scientist I drew is female, female.	8

When Table 2 is examined, it is seen that the male (f = 56) response is higher than the female (f = 8) response in the question about the gender of the scientist in the drawings of the secondary school eighth grade students.

The third question of the research was "What are the data for the students who have a male scientist image in their minds?". In order to answer this question, students who answered the first question of the semi-structured interview form with "Male" was asked the question of "*What are the cases you used for drawing the scientist as a male?"* and the codes and categories derived from the analysis of answers given to this question are shown below.

Table 3.
Data of students with the scientist image of male gender

Theme	Category	Code	Frequency
Data on Scientist's Gender being Male	What They See Around	The scientist I have seen around me is male, scientists I have seen are male	21
	Visual Media	Scientists I see in TV, cartoons, movies, documentaries are male	14
	Printed Sources	The scientists I have seen in the textbooks are male	7
	Popular Scientists	Well-known scientists and inventing scientists are male	7
	What Comes to Their Mind	What comes to mind when a scientist's gender is mentioned	7
	Traditional Gender Patterns	Working in a lab is a man's work, women cannot be scientists, men are patient, scientists were men back in time	4

When Table 3 is examined, it is seen that the main data sources of the male gender image belonging to the scientist formed in the minds of secondary school students are what they see around (f = 21) and visual media (f = 14) respectively. These are followed by printed sources (f = 4), popular scientists (f = 7), (f = 4) and traditional gender patterns (f = 4). Below is a section taken from the interview made with S59, who is a male student.

Researcher: Is the scientist in this drawing female or male?

Student, Code S59: Male

Researcher: What are the cases you used for drawing the scientist as a male?

Student, Code S59: I was impressed by Einstein and also, there are usually male scientists in the books.

When the data obtained from the semi-structured interview form of the student coded S60 was analyzed, it was coded that the student's claim on the scientist's gender is male and the reasons for doing this are popular scientists and printed sources.

Fourth question of the study was "What are the data for the students who have a female scientist image in their minds?". In order to answer this question, students who answered the first question of the semi-structured interview form with "Female" was asked the question of "*What are the cases you used for drawing the scientist as a female?"* and the codes and categories derived from the analysis of answers given to this question are shown below.

Table 4.
Data of students with the scientist image of female gender

Theme	Category	Code	Frequency
Data on Scientist's Gender being Female	Visual Media	The scientists I have seen, in the TV, are female	3
	Printed Sources	The scientists I have read about on books and magazines are female	3
	As a Reaction to Traditional Gender Patterns	Women can be scientists, too	3
	Popular Scientists	Well-known scientists and inventing scientists are female	1
	Influence of the Classes	I saw it during the class	1

When Table 4 is examined, it is seen that the main data sources of the female gender image belonging to the scientist formed in the minds of secondary school students are visual media (f=3), printed sources (f= 3) and as a reaction to the traditional gender patterns (f=3) respectively. These are followed by scientists (f =1), whoever comes to mind (f=4), and the influence of the classes (f=4). Below is a section taken from the interview made with S43, who is a female student.

Researcher: Is the scientist in this drawing female or male?

Student, Code S47: Female

Researcher: What are the cases you used for drawing the scientist as a female?

Student, Code S47: People thinks that women cannot be scientists because of the scorn towards women. My teacher told us that women can be scientists, too and showed us some example photos

When the data obtained from the semi-structured interview form of the student coded S47 was analyzed, it was coded that the student's claim on the scientist's gender is female and the reasons for doing this are as a reaction to the traditional gender patterns and influence of the classes.

"What are the rationales for the students who have a male scientist image in their minds?" was the fifth question of the research. In order to answer this question, students who answered the first question of the semi-structured interview form with "Male" was asked the question of "*Can you explain the reasons for drawing the scientist as a male?"* and the codes and categories derived from the analysis of answers given to this question are shown below.

Table 5.Rationale of the students with the male scientist image

Table 5.
Rationale of the students with the male scientist image

Theme	Category	Code	Frequency
Rationale for Scientist's Gender being Male	What They See Around	The scientists I have seen are usually male, I have not seen any female scientists	16
	Printed Sources	All the scientists in the science textbook, all the other books such as social studies textbook and even in magazines are male	14
	Visual Media	Scientists are shown as males in the TV or movies	12

	Traditional Gender Patterns	Men are smarter, more brave better in jobs that are dangerous and require strength, men are stronger, women are more delivate	12
	Classes	Our teacher taught it during the class, I saw it in the science class	4
	Significant Inventions	Male scientists have more significant inventions	2
	Popular Scientists	Well-known are scientists are male	1

When Table 5 is examined, it is seen that the main sources of the rationale for the male gender image belonging to the scientist formed in the minds of secondary school students are what they see around (f = 16) and printed media (f = 14) respectively. These are followed by visual media (f=11) ve traditional gender patterns (f=11) respectively. Below is a section taken from the interview made with S42, who is a male student.

Researcher: Is the scientist in this drawing female or male?

Student, Code S42: Male

Researcher: What are the cases you used for drawing the scientist as a male?

Student, Code S42: I've only seen male scientists in textbooks

Researcher: Can you explain the reasons for drawing the scientist as a male?

Student, Code S42: Male scientists have more significant inventions

When the data obtained from the semi-structured interview form of the student coded S42 was analyzed, it was coded that the student's claim on the scientist's gender is male and while his source for such data is printed sources, he claims that his rationale for drawing the scientist as a male is the significant inventions.

"What are the rationale for the students who have a female scientist image in their minds?" was the sixth question of the research. In order to answer this question, students who answered the first question of the semi-structured interview form with "Female" was asked the question of "*Can you explain the reasons for drawing the scientist as a female?"* and the codes and categories derived from the analysis of answers given to this question are shown below.

Table 6.
Rationale of the students with the female scientist image

Theme	Category	Code	Frequency
Rationale for Scientist's Gender being Female	As a Reaction to Traditional Gender Patterns	Women can be successful, too, they can work instead of being housewives, women can be scientists too, women are more competent	6
	Influence of the Classes	I saw it in the social studies class	1
	Significant Inventions	Women can make as significant inventions as men	1

When Table 6 is examined, it is seen that the main rationale the female gender image belonging to the scientist formed in the minds of secondary school students is a reaction to the traditional gender patterns (f = 6). This is followed by the influence of the classes (f=1) and beneficial inventions (f=1). Below is a section taken from the interview made with S43, who is a male student.

Researcher: Is the scientist in this drawing female or male?

Student, Code S43: Female

Researcher: What are the cases you used for drawing the scientist as a female?

Student, Code S43: I think of female scientists such as Marie Curie when a "scientist" is mentioned. I have seen her in my English book.

Researcher: Can you explain the reasons for drawing the scientist as a female?

Student, Code S43: Women can make as significant inventions as men.

When the data obtained from the semi-structured interview form of the student coded S43 was analyzed, it was coded that the student's claim on the scientist's gender is female and the reasons for doing this are popular scientists and influence of the classes.

"What are the promoters for the students who have a male scientist image in their minds?" was the seventh question of the research In order to answer this question, students who answered the first question of the semi-structured interview form with "Male" was asked the question of "*How can you promote your reasons for drawing the scientist as a male?"* and the codes and categories derived from the analysis of answers given to this question are shown below.

Table 7.
Promoters of the students with the male scientist image

Theme	Category	Code	Frequency
Promoters for Scientist's Gender being Male	Popular Scientists	I thought of Mendel, other scientist examples (Edison, Einstein, Aziz Sancar, ...)	27
	Traditional Gender Patterns	Women give up easily, men are smarter, men are more competent, men are more succesful	13
	Visual Media	Movies, news, cartoons	7
	Significant Inventions	Men make significant inventions	4
	Printed Sources	Books I have read	2
	Number of Male Scientists	There are more male scientists compared to women	2

When Table 7 is examined, it is seen that the main sources of the promoters for the male gender image belonging to the scientist formed in the minds of secondary school students are popular scientists (f = 27) and traditional gender patterns (f = 13) respectively. These are followed by visual media (f=7), significant inventions (f=4), printed sources (f=2) and number of male scientists (f=2). Six students did not answer this research question. Below is a section taken from the interview made with S42, who is a male student.

Researcher: Is the scientist in this drawing female or male?

Student, Code S24: Male

Researcher: What are the cases you used for drawing the scientist as a male?

Student, Code S24: Science is men's work

Researcher: Can you explain the reasons for drawing the scientist as a male?

Student, Code S24: I saw it in the science class

Researcher: "How can you promote your reasons for drawing the scientist as a male?"

Student, Code S24: I can give Edison as an example

When the data obtained from the semi-structured interview form of the student coded S24 was analyzed, it was coded that the student's claim on the scientist's gender is male and while his source for such data is traditional gender patterns, he claims that while his rationale for drawing the scientist as a male is the influence of the classes, his reason for drawing the scientist as a male is the popular scientists.

The last question asked within the framework of the study was the question of "What are the promoters for the students who have a female scientist image in their minds?" In order to answer this question, students who answered the first question of the semi-structured interview form with "Female" was asked the question of "*How can you promote the reasons for drawing the scientist as a female?"* and the codes and categories derived from the analysis of answers given to this question are shown below.

Table 8.
Grounds of the students with the female scientist image

Theme	Category	Code	Frequency
Grounds for Scientist's Gender being Female	As a Reaction to Traditional Gender Patterns	Women can be scientists too, women can be successful too	6
	Popular Scientists	Marie Curie as an example	2

When Table 8 is examined, it is seen that the main sources of the promoters for the female gender image belonging to the scientist formed in the minds of secondary school students are traditional gender patterns (f = 6) and popular scientists (f = 13) respectively. Below is a section taken from the interview made with S12, who is a male student.

Researcher: Is the scientist in this drawing female or male?

Student, Code S12: Female

Researcher: What are the cases you used for drawing the scientist as a female?

Student, Code S12: Women can be scientists

Researcher: Can you explain the reasons for drawing the scientist as a female?

Student, Code S12: I saw it in the social studies class

Researcher: "How can you promote your reasons for drawing the scientist as a female?"

Student, Code S12: Marie Curie, for example

When the data obtained from the semi-structured interview form of the student coded S12 was analyzed, it was coded that the student's claim on the scientist's gender is female and while his source for such data is a reaction against traditional gender patterns, he claims that while his rationale for drawing the scientist as a female are the influence of the classes and his reason for drawing the scientist as a male is the popular scientists.

DISCUSSION, CONCLUSION and SUGGESTIONS

When the data obtained from the semi-structured interview form of the student coded S12 was analyzed, it was coded that the student's claim on the scientist's gender is female and while his source for such data is a reaction against traditional gender patterns, he claims that while his rationale for drawing the scientist as a female are the influence of the classes and his reason for drawing the scientist as a male is the popular scientists. In this study, where the reasons for the image on secondary school students' minds on scientists is revealed, it is observed that the scientist image in the students' minds is predominantly male. This result coincides with many studies in the literature (Baday, 2019; Balçın & Ergün, 2018; Chambers, 1983; Güler & Akman, 2006; Karaçam, 2015; Medina-Jerez et al., 2011; Rodari, 2007). It is seen that only a small portion of students have a female scientist image in their minds. However, the study carried out by Monhardt (2003) shows that the scientist image in secondary school students' minds are mostly female in contradiction with this study. Almost all of the students participated in this research drew a male scientist when they are asked to draw a scientist. Similar results were achieved in the studies of Christidou (2010) and Korkmaz and Seçken (2015).

In the research, after the images in the minds of the students regarding the gender of the scientist were determined, each student was interviewed to investigate the reasons for having these images in depth. The aim of these interviews was to compare scientist gender in the students' minds with the claims of the scientist's gender. As the conclusion of the results obtained from students' drawings and interviews made with them; it is observed that students with a male scientist image in their mind also claims that the scientists' gender is male and students with a female scientist image in their mind also claims that the scientists' gender is female. This reveals that students' scientist image in their minds and their claims on the scientists' gender coincide with each other. Images emerging about a concept emerge as a result of the interaction of people with the world they live in (Norman, 1983). In order for the idea in the mind of people to turn into a picture, it is necessary to activate the imagination of the person, and this only happens through images (Atasoy, 2004).

After the claims about the images of the students regarding the gender of the scientists were revealed, the data they used to make these claims were examined. As a result of the interviews made with the students who put forward the image and claim of the scientist being male, it is revealed that their resources of the data causing such a claim are "What They See Around" and "Visual Media" and as a result of the interviews made with the students who put forward the image and claim of the scientist being female, it is revealed that their resources of the data causing such a claim are "Visual Media", "Printed Sources" and "As a Reaction to the Traditional Gender Patterns". This situation coincides with many studies in the literature which shows these sources have influence on students on the scientist's image in their minds regarding gender. (Bang, Wong & Jeffery, 2014; Karaçam & Digilli Baran, 2017; Özdeş & Aslan, 2019; Steinke vd., 2007).

After the claims about the images of the students regarding the gender of the scientists were revealed, the rationale they used to make these claims were examined. As a result of the interview made with the students whose image and claim about the gender of the scientist is male, it was concluded that the reasons they used to reveal this image and claim were “What They See Around” and “Printed Sources”. When we look at the studies examining science textbooks from printed sources, it is seen that mostly male scientists are used in the visuals in these books (Göksu & İnaltekin, 2020; Karaçam, Aydın & Digilli, 2014). As a result of the interview made with the students whose image and claim about the gender of the scientist is female, it was concluded that the reasons they used to reveal this image and claim was "A Reaction to the Traditional Gender Patterns". In the study carried out by Özdeş and Aslan (2019), it was revealed that the female students who drew the image of the scientist in their mind regarding gender as female explain this situation as a reaction to the traditional gender patterns (women are also intelligent, women and men are equals, etc.).

After the claims, data and rationale about the images of the students regarding the gender of the scientists were revealed, the promoters they used to make these claims, data and rationale were examined. As a result of the interview made with the students whose image and claim about the gender of the scientist is male, it was concluded that the promoters they used to reveal this image and claim was "Popular Scientists" and the interview made with the students whose image and claim about the gender of the scientist is male, it was concluded that the promoters they used to reveal this image and claim was "As a Reaction to the Traditional Gender Patterns" such as their rationale. While the students with a male scientist image in their minds show scientists such as Mendel, Edison, Einstein and Aziz Sancar, who they deem to be popular, mention these scientists as grounds during the interviews, the students with a female scientist image in their minds used expressions such as "Women can be scientists, too", "Women can be successful, too" as grounds which are categorized within "Reactions to traditional gender patterns".

As a result of this study conducted with the purpose of evaluation of the scientists' image in secondary school students' minds regarding gender in accordance with Toulmin's Argumentation Model, it was seen that the image in students' mind regarding scientists' gender is predominantly male. The students explain the main reasons for having such a stereotypical image on scientists' genders as their personal observations, visual media, printed sources and popular scientists. On the other hand, it is also observed that scientist' image in some students' mind is female and these students explain this situation as a reaction to the visual media, printed sources and traditional gender patterns.

This study reveals the reasons for the scientists' image in students' minds regarding gender. Considering these reasons, it is thought that posts shared on these sources concerning scientists can be revised and the stereotyped scientist images that may occur in the students can be prevented. By conducting the research at different levels of education and on different scientist image indicators, deeper information about the causes of scientist image formation can be obtained. Considering the results of the research the images of scientists in the minds of our children, who are the prospective scientists of the future, are thought to have an impact on the students' engagement in this field and it is anticipated that students' conducting in and off-class researches on these matters and providing an interactive discussion environment in the class will influence the scientist image in students' minds (Harman & Şeker, 2017).

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