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The Origins of Perceptions regarding Gender of Scientist among Secondary School Students

Ortaokul Öğrencilerinin Bilim İnsanının Cinsiyetine Yönelik Algılarının Kökenleri

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ABSTRACT: The purpose of this study is to investigate the origins of secondary school students' perceptions of gender of scientist. For this purpose, phenomenology, one of the qualitative research techniques, was used in this study. Totally 592 students from five secondary schools in the central of Düzce participated in this study in 2014-2015 academic years. To determine students' perceptions of gender of scientist, a questionnaire consisting of open-ended questions and a semi-structured interview were developed. Although the questionnaire was administered to all students, the interviews were conducted with 120 students selected randomly. The data obtained through data collection techniques were combined and encoded by two researchers participating in the research process. The results of the study indicated that students' cultural background, scientist figures presented in printed and visual media and the use of the terms "Man of Science" or "Scientist" to identify people specialized in science affected students' perceptions of gender of scientists. According to cultural background, while some students adopting traditional/ patriarchal culture identified scientist as a male based on male gender linked stereotypes or as a female based on female gender linked stereotypes, others adopting modern/western culture and protesting gender linked stereotypes thought scientist as a male and female.
Keywords: Scientist image, male scientist, career choice

ÖZ: Bu çalışmanın amacı ortaokul öğrencilerinin bilim insanının cinsiyetine yönelik algılarının kökenlerini incelemektir. Araştırmaya Düzce merkez ilçede bulunan beş ortaokulda 2014-2015 öğretim yılında öğrenim gören 592 öğrenci katılmıştır. Araştırmada öğrencilerin bilim insanının cinsiyetine yönelik algılarını belirlemek için açık uçlu sorulardan oluşan bir anket uygulanmış ve yarı yapılandırılmış görüşme yapılmıştır. Anket tüm öğrencilere uygulanmasına karşın, yarı yapılandırılmış görüşme rastgele seçilen 120 öğrenciyle yapılmıştır. Veri toplama araçlarından elde edilen veriler birleştirilmiş ve iki alan uzmanı tarafından kodlanmıştır. Araştırma sonucunda öğrencilerin kültürel alt yapılarının, yazılı ve görsel medyada sunulan bilim insanı figürlerinin ve toplumda bilim alanındaki uzmanları tanımlamak için "bilim adamı" kavramının kullanılmasının öğrencilerin bilim insanının cinsiyetine yönelik algılarının etkilediği bulunmuştur. Öğrencilerin kültürel alt yapılarındaki farklılık nedeniyle, bilim insanının cinsiyetine ilişkin farklı fikirler ileri sürmüşlerdir. Geleneksel kültüre sahip öğrencilerin toplumdaki basmakalıp (maskülin) erkek imgesi temelinde bilim insanının erkek olabileceğini ileri sürmüşlerdir. Toplumdaki basmakalıp bayan imgesi temelinde bilim insanını bayan olarak tanımlarken ise, toplumdaki basmakalıp erkek ve bayan imgelerini reddetmişlerdir. Ayrıca modern/batı kültürünü benimseyen öğrenciler ise bilim insanının bayan veya erkek olabileceğini ileri sürmüşlerdir.
Anahtar Kavramlar: Bilim insanı imgesi, bilim insanı, kariyer seçimi

1.INTRODUCTION

In an increasingly globalized world, for countries to produce science and technology has become a main indicator of being powerful both economically and politically. In this process, countries generally endeavor to increase the quality of scientists. Education is the key factor in cultivating qualified scientists. After all, it is the education that will allow individuals to acquire the skills needed to be a scientist and raise an awareness of science as a profession will be achieved through the training process. In Turkey, the mission to increase the awareness of

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science and scientist might be undertaken by the science course. In this regard, the objectives of the Science Teaching Program introduced in 2013 are as follows;

1- To help students understand how scientists create scientific knowledge, the processes taking place in the creation of this knowledge and how it is used when conducting new research studies.
2- To help students understand that science emerges from the joint efforts of the scientists from all cultures and develop a sense of appreciation for scientific studies.
3- To develop a career awareness in relation to Science Education (MoNE, 2013).

Students' image of science and scientists might be considered to be the primary factor in achieving the objectives of the Science Curriculum. A large number of studies in the literature (Archer, DeWitt and Willis, 2014) report that students' image of science and scientists has an effect on their decisions to make a career in science. In this respect, the image of scientist among students from various grades is evaluated in terms of different variables. Related studies conducted in Turkey found that students image scientists as a man wearing a white coat and glasses and working in a laboratory with test equipment and this image results from textbooks, media, peers and their teachers (Karaçam, Aydın, and Digilli, 2014).

Focusing on the Turkish students' image of scientist, this study aims to investigate the origins of the secondary school students' perceptions of gender of scientists.

1.1. Image of Scientist and Its Origin

Over the last fifty years, many studies have been carried out on the image of scientist which was introduced for the first time by Mead and Metraux in 1957. Mead and Metraux (1957) asked thirty-five thousand high school students to prepare a written document concerning scientists. At the end of the research, it was found that students described the stereotype scientist image as a man with a moustache working in a laboratory full of chemical materials and tools, wearing a lab coat and glasses, reading books and taking notes and shouting "Eureka!!! Eureka!!!". Based on the theoretical basis provided by this study, though several studies were made until 1983 using different assessment techniques, the research study conducted by Chambers (1983) was the most influential one. Chambers (1983) determined 4807 students' (preschool to 5th grade) scientist images using a new approach called "Draw a Scientist Test" (DAST). As a result of his study, he found out similar finding of Mead and Metraux (1957).

Using the test and the check list provided by Chambers, many studies (Barman, 1999; She, 1995) have been conducted to examine the scientist images that individuals in different countries and at different grade levels. As a result of these studies, it is suggested that students at various grade levels have a stereotypical scientist image. Similar studies have also been carried out in Turkey. It is noteworthy that these studies (Demirbaş, 2009; Karaçam, 2015; Korkmaz & Gürçay, 2016) generally used the DAST and targeted various grade levels ranging from primary school to higher education. Results of these studies show similarities with those obtained in the studies conducted in different countries.

There are numerous assumptions regarding that students usually have a scientist image which is characterized as stereotypical, as evidenced by the studies carried out in our country and others. Türkmen (2008) suggests that the main factor underlying this image is the stereotypical image of a scientist presented in science textbooks. Another factor highlighted in the studies is the influence of the media. Steinke (2005) asserts that students have this image because scientist figures presented in printed and visual media include data inclined towards stereotypical scientist image. On the other hand, another reason why students have a stereotypical scientist image is suggested to be the social circle of the students including their parents, teachers and peers (Scott and Mallinckrodt, 2005). Nuhoğlu and Afacan (2011)

emphasize the language as the reason for having the stereotypical image. Nuhoğlu and Afacan remark that students tend to draw a male scientist as the phrase "*man of science*" is mostly preferred and used instead of "*scientist*" in our country and the "*man*" is associated with the "*male*".

1.2. Studies to Revise the Stereotypical Image of Scientist

As results of studies represented above and aiming to determine students' images of scientist, it is found that students from different countries and grade levels have a stereotype scientist image. However, Wong (2015) states that the stereotype image of scientist has a negative effect particularly on the career choices of girls about joining the world of science. Moreover, She (1998) recommends that the stereotype image of scientist needs to be revised in a way to be a more realistic scientist image. Thus there have been several studies (Leblebicioğlu, Metin, Yardımcı and Çetin 2011; Mason, Kahle and Gardner, 1991) in the literature to change the stereotypical image of scientist among students.

Five approaches have been conducted to revise students' stereotype scientist image in the literature. General purpose of these approaches is to help students realize that a scientist is a real person, encourage them to take scientists as a model and let them see the work environment of scientists and how they work. These approaches are visiting scientists (Scherz and Oren, 2006), inviting and visiting scientists (Flick, 1990) and presenting life stories of scientists (Erten, Kıray, and Şen Gümüş, 2013). Results of these studies suggest that these approaches have a positive impact on students' images of scientist, and they draw mostly female scientists.

1.3. The Significance of the Study in the Literature

Studies conducted in different countries from 1957 to today, and those conducted in our country from 2000s to today have found that students at various grade levels have the scientist image defined as stereotypical. In the literature, the origin of the stereotypical scientist image is thought to be resulting from the stereotypical figures of scientists presented in science textbooks and printed and visual media, from the words or statements of teachers, parents and peers regarding stereotypical scientist image, and from the use of "Man of Science". Moreover, it is alleged that this stereotypical image affects adversely the inclinations to make a career in the field of science (She, 1998). Making analysis based on the gender factor, Wong (2015) states that the masculine image of scientists has a negative effect particularly on the career choices of girls about joining the world of science. Therefore, She (1998) recommends that the masculine image of scientists needs to be revised in a way to be a more realistic male or female scientist image.

Due to the general opinion that stereotypical scientist image arises from the printed-visual sources and media, it is noteworthy that studies conducted in an effort to change the stereotypical scientist image mainly focus on approaches such as visiting, inviting female scientists from different cultures to the instructional environment and presenting their life stories. The main purpose of adopting this approach is to ensure that the scientists participating in the activities serve as a role model for students and thus raise awareness in students that science is a process in which a group of people with different genders and from different cultures work together. Based on the given approach and the results of the studies using it (Flick, 1990), it is suggested that this approach has a positive impact on the scientist image of students as more students compared to the pretest drew female scientists following the approach towards changing the image. It is obvious that efforts to change the stereotypical (masculine) scientist image are limited to the approaches that place opposite figures in the instructional environment. The optimal solution to overcome this hardship in the literature is to determine the perception of the gender of scientists among students. In this sense, the present study seeks to answer the question "What are the origins of the perceptions regarding the gender of a scientist

among secondary school students?" In the study, the origins of the perceptions regarding the gender of a scientist among secondary school students will be described and the results of the study might be useful for future studies about how to change and revise the stereotypical (masculine) image of scientists.

1.4. Research Question

What are the origins of the perceptions regarding image of scientist among secondary school students?

a. What are the origins of perceptions among secondary school students who define scientist as a male?
b. What are the origins of perceptions among secondary school students who define scientist as a female?
c. What are the origins of perceptions among secondary school students who define scientist as a male or female?

2. METHOD

2.1. Research Model

In the present study, which scrutinizes the origins of perception towards the gender of scientists among secondary school students, one of the qualitative research techniques, phenomenology method was used (Creswell, 2013). According to Creswell (2013), phenomenology is used to reveal the attributed meaning to an event, phenomenon or concept by individuals. The main factor in the phenomenology approach is the requirement that individuals, who are participants in the study, should have an experience of the phenomenon (Creswell, 2013). From this perspective, the concept of scientist is considered as a phenomenon and common themes of the experience of secondary school students' on the gender of scientists were interpreted within the framework of phenomenology technique in this study.

2.2.Participants

In the 2014-2015 academic year, 592 students from fifth, sixth and seventh grades of secondary education schools that are in the central district of Düzce participated in this study. In selection of the schools, volunteerism of the teachers was taken into consideration, thus, before the decision-making, meetings were held with the science teachers from all schools. Five schools were randomly selected from the group of schools at which the teachers volunteered to support this research. The implementation was carried out for all fifth, sixth and seventh grade science classes of the volunteering teachers; no selection based on grade level was made.

Table 1: Frequency and percentage distribution of participants according to gender and education level

Education Level	Male		Female		Total	
	f	%	f	%	f	%
5	102	17.23	111	18.75	213	35.98
6	97	16.38	96	16.22	193	32.6
7	95	16.05	91	15.37	229	31.42
Total	294	49.66	298	50.34	592	100

2.3.Implementation

The implementation for this research was conducted during the fall semester of the 2014-2015 academic years. In this implementation, first a questionnaire consisting of open-ended questions was applied in classes, in order to determine students' perception on the gender of scientists. Subsequent to this survey, semi-structured interviews were held with the randomly

selected hundred and twenty students among the participants. Questionnaires, consisting of open-ended questions, were administered by teachers. The semi-structured interviews were carried out by the researchers. Both steps of the implementation were completed in five different schools in a month.

2.4.Tools for Data Collection

In this research, a questionnaire consisting of open-ended questions, one of the techniques that facilitates to obtain the views of individuals with in-depth data and to reach many people in a short time period, was used to determine students' perceptions of gender of scientists. Altunışık, Coşkun, Bayraktaroğlu, and Yıldırım (2005) suggested that questionnaire forms allowed to reach many people in a short time and open-ended questions used in these questionnaires ensured that the participants expressed their thoughts in own words and in detail. The questionnaire that consists of open-ended questions includes two parts. Questions on the demographic characteristics of students are found in the first part. The second part consists of a single question, and in this question students are asked to choose one of the categories for gender of scientists, in the second step they were asked to explain why they think that way. A pilot study with a group of students (n=30) was conducted during the preparation process of the questionnaire in order to test the comprehensibility of the question in the questionnaire, according to the result of students' answers and conducted interviews, the questionnaire was finalized.

A semi-structured interview was held with 120 students subsequent to the questionnaire, in order to increase the reliability of the data obtained from open-ended questions and to obtain more detailed data for the views of students (Altunışık et al., 2012). The framework of the interview was considered according to the students' answers to open-ended questions. The interviews have been carried out at science laboratories in the students' schools, and before the interview students were informed about the research and researcher. No time limitation was set forth for interviews and each interview was evaluated in itself. All interview processes were voice recorded.

2.5.Analysis of the Data

In this research, aiming to scrutinize the students' perception in detail and to reveal themes related to perception, content analysis was used (Yıldırım and Şimşek, 2005). In content analysis, data are first conceptualized and then organized in a coherent manner according to the emerging concepts and themes that explain the data are identified accordingly (Yıldırım and Şimşek, 2005). Facts that may be hidden in the data could be uncovered within this framework. In this research, following steps were executed for data analysis in the scope of this approach:

- Audio recordings obtained from semi-structured interviews were converted into written form.
- Data obtained from questionnaires and semi-structured interviews were integrated.
- Data were reviewed before proceeding with coding. This process provided to have a control over the data.
- Data were coded by two researchers in order to test the reliability of the obtained results. While coding, in every 25 students, first student was checked back to. This operation facilitated the internal consistency of the given codes.
- After coding the data, a reliability study was conducted. For this step, the consistencies of the given codes by the two researchers were taken into consideration. Within this scope, 66 codes were found to be different from 828 codes, which were given by two researchers. Codes assigned differently were discussed as a group and a consensus

was reached. In order to calculate the reliability coefficient, the approach developed by Miles and Huberman (1994) was adopted. According to this approach, the consistencies between the codes given by researchers were found as 92%. Miles and Huberman (1994) suggest that the results of the study could be considered reliable in qualitative studies when 90% and more consistency exists between the codes assigned by the coders.

- In the last step, themes were identified based on the relationships between the codes assigned by the researchers.

3.FINDINGS

Initially, a general overview about findings is presented at Table 1 below. Following the Table 1, expressions of students are presented based on themes in this section.

Table 1. Percent and frequency distribution of the perceptions of students regarding gender of a scientist

Gender	Themes	Codes	Codes		Themes	
			f	%	f	%
Male or Female	Gender and Equality	Objection to gender discrimination against the professions in society	**245**	**29,59**	**422**	**50,97**
		Males and Females have similar qualifications	97	11,71		
		Freedom of career choice	80	9,67		
	Effect of Printed and Visual Media	The presence of male and female scientists in most of the sources	16	1,93	16	1,93
	Effect of Language	As the title implies "Man of Science"	15	1,81	15	1,81
				TOTAL	453	54,71
Male	Male Dominance in Society	Males are more interested in and prone to science and technology	94	11,35	**173**	**20,89**
		Males are stronger and more resilient	40	4,83		
		Males do things faster	12	1,44		
		Males are not emotional but logical	8	0,97		
		Males are more independent	8	0,97		
		Males are more creative and intelligent	7	0,85		
		Males are more patient	4	0,48		
	Effect of Printed and Visual Media	Presence of Male scientists in most sources	108	13,04	**108**	**13,04**
	Impact of Language	As the title implies "Man of Science"	9	1,09	9	1,09
				TOTAL	290	35,02
Female	Social Perception Towards Superiorities of Females	Females are more responsible	24	2,91	**85**	**10,27**
		Females get what they want	22	2,65		
		Females are more meticulous and tidier	21	2,55		
		Females go into details/question everything	18	2,16		
				TOTAL	85	10,27
				TOTAL	**828**	**100**

As seen in Table 1, the majority of students (f = 453, 54.71%), thought that the scientists might be male or female. Besides, it was seen that 35,02% of the students (f = 290) identified a scientist as male; and 10.27% (f = 85) as female.

3.1. Findings for the Views of Students Identifying a Scientist as Male or Female

It was revealed that 422 students (50.97%) describing a scientist as male or female emphasized the theme of "Gender and Equality", 16 students (1.93%) emphasized "Effect of Printed and Visual Media " and 15 students (1.81%) emphasized "Effect of Language".

3.1.1.*Gender and equality*

With regards to the theme of "Gender and Equality", it was seen that 245 students (29.59%) emphasized the category "Objection to gender discrimination against the professions in society", 97 of the students (11.71%) stressed "Males and females have similar qualifications" and 80 students (9.67%) emphasized "Freedom of career choice".

Code 1. Objection to gender discrimination against the professions in society

It is pointed out that the students emphasizing "Objection to gender discrimination against the professions in society" argue that females could also be a scientist by going against the common views and beliefs in the society that have come out based on the mental and physical characteristics of individuals who practice a profession. In this category which was particularly emphasized by girls, it is noted that since students find it unfair that women are handed over the responsibility of taking care of home and children and thus forced to be a housewife and they therefore argue that a scientist might be male or female. Some of these students said:

S_{11}: *"A scientist could be both male and female. Because, there is no such a thing that any job can only and always be performed by men …"*

S_{54}: *"… A scientist could be either a male or a female… Just like that women can also drive a truck today. …Or washing dishes, cooking meals and ironing is not for females. So, a scientist can be male or female."*

Code 2. Males and females have similar qualifications

Students emphasizing this category generally underline that everyone, either male or female, has similar qualities because they are human beings. Some of these students said:

S_{8}: *"Male or female. Both male and female have the same mind. Whoever uses it wins."*

S_{100}: *"It could be male or female. Because, anyone who is smart can carry his/her country one step further. In quality, nobody is superior to anybody."*

S_{291}: *"I think, it might be male or female because the important thing here is thinking. And both of them can do it."*

Code 3. Freedom of career choice

Students thought a scientist could be male or female because of the freedom of career choice. Some of these students said:

S_{13}: *"It does not matter a scientist is male/female. Anyone who wants to be a scientist or loves science can be a scientist because everybody is free."*

S_{421}: *"Scientist could be male or female. Anyone who studies or thinks that s/he has a talent can choose this profession. Everybody is free to study whatever they want and this cannot be prevented."*

3.1.2. *Effect of printed and visual Media*

Based on their experiences, 16 (1.93%) students emphasizing the theme "Effect of Printed and Visual Media" thought that a scientist could be male or female because scientist figures are represented in a way to include both gender in lots of the sources such as printed and visual media, textbooks and internet. So, a code was created under this theme and it was identified as "The presence of male and female scientists in most sources". Some of these students said:

S_{73}: *"A scientist might be male or female. There have been lots of successful male and female scientists throughout the history."*

S_{238}: *"A scientist does not have a gender. ...For example, there is a male scientist, Newton and also a female scientist, Marie Curie in books. If you try hard and make an effort, you can do everything whether you are a male or female.*

3.1.3. *Effect of Language*

It is noteworthy that 15 students (%1.81) emphasizing the "Effect of Language" commented within the framework of linguistics. It was seen that students argued a scientist could be a male or a female since those who deal with science are called a scientist and the concept of human being symbolizes both gender without valuing one above the other. A single code was created for the opinions of the students emphasizing this theme and this code was identified as "As the title implies, the Man of Science". The opinions shared by some of these students are:

S_{319}: *"I can't define it as male or female. After all, we do not say "man of science", but just "scientist". Well, does it make a change when we say male or female? They are both human beings.*

S_{685}: *"Because people dealing with science could be both male and female, we use 'scientist'.*

3.2. Findings for the Views of Students Who Identify a Scientist as Male

It is seen that students defining a scientist as male emphasized the themes "Male Dominance in Society" (f=173, %20.89), "Effect of Printed and Visual Media" (f=108, %13.04) and "Effect of language" (f=9, %1.09).

3.2.1. *Male dominance in society*

It is remarkable that students underlining the theme "Male Dominance in Society" generally made their statements under the influence of patriarchal culture.

Within this theme, 94 students (11.35%) put the emphasis on "Males are more interested in and prone to science and technology", 40 students (4.83%) on "Males are stronger and more resilient", 12 students (1.44%) on "Males do things faster", 8 students (0.97%) on "Males are not emotional but logical", 8 students (0.97%) on "Males are more independent", 7 students (0.85%) on "Males are more creative" and 4 of the students (0.48%) emphasized the category of "Males are more patient". Conceptual categories and findings for these categories are presented below;

Code 1. Males are more interested in and prone to science and technology

Students emphasizing the code "Males are more interested in and prone to science and technology" argue that male scientists have more interest in science, scientific innovations and technological devices and they are also more skillful and knowledgeable than females. For that reason, they think that scientists are male. Some of these students said:

S_{91}: *"…Males and females are different mentally. Males are more skillful than females about science and technology. Women should not try to do a man's job."*

S_{94}: *"…How can a female who does not know how to drive can invent a car?"*

S_{213}: *"…Females cannot touch electrical appliances but males can."*

Code 2. Males are stronger and more resilient

Students emphasizing "Males are stronger and more resilient" comment that scientific activities require strength and endurance since they are very difficult and include dangers and the males are stronger and have more endurance than females, so scientists are males. Some of these students said:

S_{108}: *"Scientists are male. There are heavy machines and women cannot handle it. Besides, there are dangerous substances that might poison women. So, only men can endure all these."*

S_{139}: *"I think scientists are male. Men are strong. Women can be a housewife because doing housework doesn't require so much strength."*

Code 3. Males do things faster

Students emphasizing "Males do things faster" generally state that females busy themselves with other things while doing science but males, contrary to females, do things faster as they keep busy with science. Some of these students said:

S_{67}: *"…Males do things faster. If scientist were females, they would do everything very slowly and everything might be delayed."*

S_{72}: *"Scientists are always engaged in their jobs. They hardly have time to breath. But females like talking, so they cannot finish their work. So, I think a scientist is male."*

S_{78}: *"…Males are fast and more hardworking than females."*

Code 4. Males are not emotional but logical

Students focusing on the code "Males are not emotional but logical" state that females are easily influenced by the external factors as they are emotional but males act logically regardless of these factors. They, therefore, conclude that scientists are male. Some of these students said:

S_{106}: *"I think that scientists are male because females generally think emotionally. Because males think on the basis of logic, they manage to be scientists."*

S_{263}: *"… Females are romantic and they are more interested in other things in their environment. A scientist should not do that. S/he should avoid evil ideas and try to get just what is needed …"*

Code 5. Males are more independent

Students emphasizing this category generally express that males feel more independent and thus are involved in scientific activities more freely because parents in Turkish society let males live more independently in the community from an early age and because there exists a belief that women are responsible for taking care of home and children. Some of these students stated:

S_{56}: *"Scientists hardly ever find time to even get their hair cut. Scientists who say "enough is as good as a feast" work about 20 hours a day. They cannot even take the time to eat. I think, they do not think much about their wife and children but female do. So, scientists are male."*

S_{147}: *"I think scientists are male as males can do whatever they want whenever they wish. Women cannot find enough time for experiments since they constantly do household chores and look after their children."*

Code 6. Males are more creative and intelligent

It was seen that students stressing "Males are more creative and intelligent" generally expressed that scientists must be intelligent and creative and males are so. For that reason, they think scientists are male. Some ideas shared by these students are:

S_{196}: *"Scientists are male because men have a productive mind. Therefore, they are more creative than girls. Men come up with interesting ideas and beautiful inventions"*

S_{298}: *"Scientists are male because males are more intelligent and creative than girls."*

S_{221}: "*Scientists are male. Men are intelligent and they are superior to women mentally. Men's creativity is due to their superior mind."*

Code 7. Males are more patient

Students underlining "Males are more patient" note that scientists need to display perseverance and be patient and should not rush to obtain results. Patience here includes being determined and diligent as it implies that a scientist should keep trying and trying without putting aside the scientific activities. Some of these students said;

S_{209}: *"Scientists should be patient. In fact, this is very important. A man is more patient than a woman. And therefore, scientists are male."*

S_{406}: "*Scientists should be patient. By reason of the fact that men are more patient than women, scientists should be men."*

3.2.2. *Effect of printed and visual media*

108 of the students (%13.04) emphasizing the theme "Effect of Printed and Visual Media" suggest that scientists are more likely to be male due to fact that scientists are represented as male in many sources such as printed and visual media, textbooks and internet. So, a code was created within this theme and it was defined as "Presence of male scientists in most sources". Some of these students said:

S_{227}: *"Scientists are male. When we analyze the books we see that most of the important inventors like Einstein and Edison are male."*

S_{327}: *"The inventors that I know are usually male. Most of the scientists are male with white hair and white beard wearing a white coat."*

S_{422}: *"Scientists are males because there are lots of male scientists on TV and in the newspapers all the time."*

3.2.3. *Effect of language*

It is remarkable that 9 of the students (%1.09) emphasizing the theme "Effect of language" commented within the framework of linguistics. It was seen that students asserted that scientist might be male because those who deal with science are called a scientist and the concept of "Man" refers to males. So, a code was identified for the statements of students emphasizing this theme and it was defined as "As the title implies 'Man of Science". Some of these students said;

S_{44}: *"I think, male. Based on the title and the experiences in our daily life, I think they are male."*

S_{51}: *"Male. I think, there is no reason to be so. They generally say "Man of Science", and "Woman of Science" does not sound good …"*

S_{371}: *"Scientists are male. … because it is called 'Man of Science' everywhere. I have never heard something like 'Woman of Science' anywhere."*

3.3.Findings for the Views of Students Who Identify Scientists as Female

All of the 85 students (%10.27) defining scientists as female put forward arguments that scientists are female based on the social perception regarding the superiorities of females; so all codes were grouped under a single theme. As students emphasized the female portrait which is outlined by the patriarchal culture, this theme was identified as "Social Perception towards Superiorities of Females"

3.3.1. *Social perception towards superiorities of females*

In relation to this theme, it was seen that 24 of the students (2.91%) emphasized "Females are more responsible", 22 students (2.65%) emphasized " Females get what they want", 21 students (2.55%) focused on "Females are more meticulous and tidier" and 18 of the students (2.16%) underlined "Females go into details/question everything". These categories are presented below;

Code 1. Females are more responsible

Students emphasizing "Females are more responsible" express that women are more responsible than men and they love their jobs, so scientists need to be like that. In this sense, they asserted that scientist should be female. Some of these students said:

S_{62}: *"…Girls are more responsible and can concentrate hard. Unlike men, they do not lose their concentration very easily."*

S_{134}: *"I think, female. … we as girls go home after school and study our lessons. But, boys watch TV. As they do not know their responsibilities, they play football and waste time on their mobile phones. For that reason, I think scientists are female."*

Code 2. Females get what they want

It was found that students emphasizing this category expressed that females made any effort possible showing patience and determination in order to get whatever they want. Some of these students stated the following ideas;

S_{19}: *"…Girls are more patient than males. They show patience and do not give up until finishing their invention. They get what they want."*

S_{74}: *"…Girls are more determined than boys and they get what they want"*

S_{273}: *"Scientists are female because chemicals can be very hazardous. But in order to get what they want, they take every chance and go all lengths."*

Code 3. Females are more meticulous and tidier

Students underlining the code "Females are more meticulous and tidier" consider scientists to be female suggesting that a scientist must be a clean and tidy person and females, as compared to males, are more meticulous and tidier than males. Some of these students said:

S_{109}: *"They are female because scientists need to be meticulous and tidy when working, just like females."*

S_{394}: *"The scientist in my dream should be a woman. Women are more meticulous and tidier than men. They know what to put where. Scientists should be tidier so that they don't have to look for something for hours."*

Code 4. Females go into details/question everything

Students emphasizing the code "Females go into details/question everything" comment that females have a character trait such as going into every detail and questioning everything like scientists. Some of the students said:

S_{420}: *"Scientists are female because females like searching, questioning and exploring every nook and cranny."*

S_{367}: *"I think scientists are female because they think in a more different and detailed way than males*

S_{222}: *"Scientists are females because females question everything and think up to the finest details like scientists."*

4.DISCUSSION

As a result of this study, which is specific in examination of the perceptions of students towards the gender of scientists, it was found that the use of terms "Scientist" or "Man of Science" was one of the factors that affected the perceptions of students towards the gender of the scientist. In other words, among the students participated in this study those who use the concept "Man of Science" to define specialists in the area of science mainly suggest that the scientist is male, and those who use the concept "Scientist" suggest that the scientist could be male or female. This factor stems from linguistics and could be unique for Turkish language. Similarly Nuhoğlu and Afacan (2011) suggest that "Man of Science" is used as a phrase to define specialists in area of science, hence the word "Man" is used to define male in Turkish the students tend to perceive the scientist as a male. In the framework of these findings Nuhoğlu and Afacan (2011) argue that the concept of "Scientist" should be used instead of the concept "Man of Science", in order to define specialists in area of science and to change the masculine image of scientists.

During the research it was determined that another factor that affects students' perception towards the scientists' gender is the scientist figures appearing in printed or visual resources. Students participating in this study identified the origin as printed and visual resources without making a distinction between books, newspapers as in the literature, yet mentioned scientist figures represented in books, magazines, television, and newspapers. Similarly, Steinke (2005) indicates that scientist figures presented in the printed and visual media are responsible as the origin of the stereotypical image.

In this research, according to students' cultural background adopting or rejecting male and female gender linked stereotypes has been found as another factor influential on the students' perception of scientists' gender. In addition, students' tendency to express this factor more in comparison to the other two factors makes one contemplate that this factor is more influential on the students' perception of scientists' image and gender. Particularly, the fact that students from various cultures have a stereotypical image of scientists reinforces the assumption that this image is obtained via stereotypical images presented in the printed and visual resources. On the basis of this assumption, Steinke (2005) defines stereotypical image as a popular image. From this perspective, Steinke suggests that all individuals create this image under the influence of popular culture, and ignores the influence of local (regional) culture on the image of scientists. On the contrary, Archer et al. (2014) argue that culture of the students' stems from masculine perception of science and scientists. The findings of the research are supported with the findings of Sikora and Saha (2009), yet are not supported by of Steinke

(2005). The data obtained in this study need to be scrutinized further in order to eliminate the discrepancy on whether the local culture, thus the gender linked stereotypes are effective on the perception of scientists' gender.

In this research it is realized that some of the students, who adopt gender linked stereotypes, perceived the scientist as male within the framework of male gender linked stereotypes, while others perceived the scientist as female within the framework of female gender linked stereotypes. Moreover, students who refuse gender linked stereotypes suggested that scientists could either be male or female. It is determined that students who define scientists as male used male gender linked stereotypes, such as being strong and resilient, approaching events logically not emotionally, being more independent in comparison to females, and those who defined scientists as female used female gender linked stereotypes, such as being more organized, meticulous, responsible, cunning and elaborative. Is it possible to consider the defined stereotypes as cultural elements? Charity-Leeke (2012) states that male and female gender linked stereotypes affect socio-cultural roles and expectations of these groups and are commonly over-generalized by public. Jackson and Scharman (2002) define male gender linked stereotypes' descriptors as physically strong, assertive, albeit aggressive, those who work outdoors, who work with their hands, who are breadwinners for their families and female descriptors as gentle, unassertive, team players, more interested in people than things, nurturers, caregivers, and homemakers. The findings of this research as well have parallels with the findings in literature, both for male and female gender linked stereotypes.

Although there are no similar stereotypes found in literature, it is necessary to investigate whether the consequential stereotypes of this research have grounds in Turkish culture. Significant data could be retrieved from the investigation of Turkish proverbs. Küçük (2003), who studied the definition of male and female in Turkish proverbs, asserts that the female, defined as meticulous and organized in proverbs, is considered as the person who makes the house home, while being regarded as less intelligent, yet more cunning than the male, and is defined as "long in hair, short in intelligence" by the male. According to Küçük (2003), in Turkish proverbs the female sensuality is portrayed as stronger than male, hence females have the nature to follow own emotions. Yet, the male sensuality is weak, the nature becomes opposite. The male identified in Turkish proverbs are brave, strong enough to withstand all challenges and resilient (Küçük, 2003). Once the findings of Küçük investigated, it is possible to suggest that the consequential stereotypes of this research exist in the proverbs that mirror traditional Turkish culture and students who adopt male and female gender linked stereotypes are likely to explain their perceptions on the scientists' gender in the framework of traditional Turkish culture. In addition, it is evident that students who refuse male and female gender linked stereotypes and assert that scientists could either be male or female do not explain their perceptions on the scientists' gender in the framework of traditional Turkish culture. It is possible to contemplate that students who refuse male and female gender linked stereotypes and assert that scientists could either be male or female could have embraced a more modern/western culture when compared to the students who adopt male and female gender linked stereotypes and these students might have explained their perceptions in the framework of such cultural background. Similarly, Sikora and Saha (2009) put forward that individuals who adopted modern/western culture are less likely to get influenced by male and female gender linked stereotypes, thus in western countries with modern culture social gender inequality, the classification of professions based on gender and the masculine perception of science are less in comparison to less developed and developing countries. Moreover, Sikora and Saha suggest that in less developed societies, where traditional culture is predominant, masculine perception of science is very common, yet in developing countries this perception becomes more fragile in the framework of modern culture. According to the findings of this research, similar to Sikora and Saha (2009), in Turkey, as a developing country, although students have the perceptions that

scientists could be male in the framework of traditional/patriarchal culture, a response exists with students who have the perceptions that scientists could be either male or female in the framework of modern/western culture. In the perspective of findings of this research and discussions, although printed and visual resources presenting the image of scientist are influential on the students' perception of scientists' gender, it should not be assumed that the perception is formed solely based on the popular culture due to printed and visual resources and the refusal of local culture.

5.CONCLUSION and IMPLICATIONS

According to the findings of this research, which investigates the secondary school students' perceptions on the scientists' gender, students' perceptions on the scientists' gender are influenced by factors such as the scientist figure presented in printed or visual resources, using concepts such as "Scientist" or "Man of Science" to define scientists, and whether the students adopt gender linked stereotypes based on modern or traditional culture. These findings call attention to the responses of research participant students, who claim that scientists could be either male or female, expressed the term "scientist" since this concept qualifies both genders, on the contrary those who claim that we define scientists as "Man of Science", expressed the term scientist within the concept of "Man", thus the scientists are male. In this regard, it is possible to consider that using the term "Scientist" instead of the term "Man of Science" would be important in altering the masculine perception of the society towards scientists and being attentive in using the concept "Scientist" in the interactions of all teaching materials and stakeholders in education would be effective (Nuhoğlu and Afacan, 2011). Another factor that affects the students' perceptions towards the scientists' gender is the scientist image presented in printed or visual resources. In the research conducted by Karaçam et al. (2014), especially on scientist figures in science text books, it is concluded that majority of scientists presented in text books are male and the only example for a female scientist is Marie Curie. In this perspective, it is important to argue that female scientists should become a part of the printed or visual resources, especially in text books.

In the research conducted to determine the scientist image individuals have in various countries, male scientist figure is addressed as the stereotype, female scientist figure is not considered as a stereotype. Hence, as a result of this study, it is determined that students who adopt a traditional/patriarchal culture define scientists as male in the framework of male gender linked stereotypes and as female in the framework of female gender linked stereotypes. On the contrary, students who adopt a modern/western culture express that scientists could be either male or female in the framework of refusing gender linked stereotypes. According to these findings, it becomes necessary to elaborate the male scientist drawings of individuals for "Draw A Scientist Test", used to determine the scientist image for the individuals, further than defining them in stereotypes. In this regard, stereotypical (masculine) scientist image should be defined as "a male, specialized in science, described with statements based on male gender linked stereotypes such as being strong and resilient, being patient and/or supported by the scientist image presented in printed or visual resources."

She (1995), who asserts that the masculine perception towards scientists is the most significant barrier for females to build a career in the area of science, emphasizes the necessity to commence with the transformation of the stereotypical male scientist image towards a more realistic scientist image. Due to the common opinion that the stereotypical scientist image is acquired from the printed-visual resources and media, especially visiting female scientists, inviting them to learning environments, conducting cooperative hand-on activities and including the biographies of female scientists in the curriculum are the approaches used in the studies that aim to alter the stereotypical (masculine) scientist image. Commonly, particular changes are mentioned in the result of these studies, since it was determined that more students draw female

scientist in the post-test in comparison to the pre-test. Therefore, it is possible to observe that, studies to alter the stereotypical (masculine) scientist image have been narrowed down to an approach that includes the contrasting figures within the learning environment and tests the level of exhibition of these contrasting figures by the students during the post-test. The result that students draw more female scientist during the post-test does not necessarily mean that the students developed a more realistic image of scientists. Hence, the students might have portrayed the female scientist within the framework of female gender linked stereotypes. In order to alter the stereotypical (masculine) scientist image towards the more realistic scientist image, it is necessary to challenge the gender linked stereotypes. Ece, a participant in the study, refuses the gender linked stereotypes based on the modern/western culture and expresses her perception as: *"Both boys and girls could become a scientist. They keep on saying that there is democracy, there is equality in our country, but there is not even a bit. They keep on telling the girls you can't do it, you can't become an engineer. They tell girls to become teachers. Many girls cannot practice being teacher after getting married because of the house work, because of taking care of the children. For boys it is not like that. Boys are freer. There is no such thing like you can't become a teacher, an engineer… There is this approach, you are a boy, you are strong, and you can overcome anything. But in Europe, it is not like that. Anyone can choose any job they want. There is no discrimination between boys and girls. There are even female taxi drivers. I am against such expressions in Turkey. Turkey should be like Europe. But in the recent years change has started. Game Over!!!"* Based on Ece's discourse, it is necessary to revise the student's perception of the scientist image towards the grounds of modern culture by using different approaches further than the use of contrasting figures. In order to achieve that, an approach which is more multi-disciplinary (social science course, art, religion, science, linguistic) should be employed for the studies that aim to alter the masculine image of scientists. In the multi-disciplinary approach, it is necessary to provide space for methods which could revise the beliefs based on male gender linked stereotypes towards the modern/western culture through examination of biographies of female scientists in the linguistic course, women's place and role in the society in the social science course, equality of male and female in Islam in the religion course, and so on and so forth. One of the most basic approaches is the biographies of scientists, although it is a multidisciplinary approach. Owens (2009), who examined the biographies of Einstein and Marie Curie in the literature, suggests that Einstein is defined as someone who breaks the rules, extraordinary and competitive person, while Marie Curie is defined as a person who respects rules, non-competitive, organized and meticulous in the biographies. It is evident that the characteristics of Einstein and Marie Curie portrayed in the biographies demonstrate similarities to the gender linked stereotypes findings of this study. Therefore, in the studies that aim alteration of the image, either biographies that do not include the gender linked stereotypes or biographies in which Marie Curie exhibits similar characteristics to Einstein should be used.

As a result, it is found out that the effect of culture is higher, even the use of scientist figure in the printed and visual sources and the use of "Man of Science" instead of "Scientist" are proven effective on the students' perception of scientists' gender. It is considered that revising the present approaches in the educational environment through contrasting figures to the stereotypical (masculine) scientist image is difficult. It could be considered that, in order to revise the stereotypical (masculine) image to a more realistic image, approaches to revise the gender linked stereotypes should be demonstrated and this would only be possible through a multi-disciplinary approach.

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Uzun Özet

1957 yılından bugüne farklı ülkelerde yapılan çalışmalarda ve 2000'li yıllardan bugüne ülkemizde yapılan çalışmalar sonucunda çeşitli öğretim kademelerinde öğrenim gören öğrencilerin basmakalıp olarak tanımlanan bilim insanı imgesine sahip olduğu bulunmuştur. Alan yazında basmakalıp bilim insanı imgesi, beyaz önlüklü, gözlüklü, kimyasal malzemeler ve araçlarla çevrili bir laboratuvarda çalışan, bazıları bıyıklı ve "Buldum!!! Buldum!!!" diye bağıran, kitap okuyan ve notlar tutan bir erkek şeklinde tanımlanmaktadır. Belirtilen basmakalıp bilim insanı imgesinin kökeni olarak ders kitaplarında, basılı ve görsel medyada sunulan basmakalıp bilim insanı figürleri, aile, öğretmen ve akranların basmakalıp bilim insanına yönelik söylemleri ve bilim alanındaki uzmanları tanımlamak için "Bilim Adamı" kavramının kullanımı gösterilmektedir. Ayrıca basmakalıp imgenin bireylerin bilim alanında kariyer yapma eğilimlerini olumsuz yönde etkilediği ileri sürülmektedir. Durumu cinsiyet temelinde inceleyen çalışmalarda maskulin bilim insanı imgesinin özellikle kızların bilim dünyasına katılma tercihlerini olumsuz etkilediğini ileri sürülmektedir. Bu nedenle maskulin bilim insanı imgesinin daha gerçekçi erkek veya bayan bilim insanı imgesi yönünde revize edilmesi gerektiği belirtilmiştir.

Alan yazındaki basmakalıp bilim insanı imgesinin basılı-görsel kaynaklar ve medyadan kazanıldığına yönelik genel kanaat nedeniyle basmakalıp bilim insanı imgesini değiştirmeye yönelik çalışmalarda özellikle farklı kültürlerden ve bayan bilim insanlarını öğretim ortamına davet etme, ziyaret etme, yaşam öykülerini sunma gibi yaklaşımların temel alındığı dikkati çekmektedir. Bu yaklaşımların izlenmesinin temel amacı etkinliklerde yer alan bilim insanlarının öğrencilere rol model olmalarını sağlamak ve böylelikle öğrencilerde, bilimin farklı kültürlerden ve cinsiyetten bir grup insanın birlikte yürüttüğü süreç olduğu algısını oluşturmaktır. Belirtilen yaklaşım veya yaklaşımların uygulandığı çalışmalar sonucunda imgeyi değiştirmeye yönelik yaklaşımlarının uygulamasının sonunda ön teste göre daha fazla öğrencinin bayan bilim insanı çizmesi nedeniyle, uygulanan yaklaşımın öğrencilerin sahip oldukları bilim insanı imgesini olumlu yönde etkilediği ileri sürülmüştür. Buradan görmekteyiz ki, basmakalıp (maskulin) bilim insanı imgesini değiştirmeye yönelik çalışmalar basmakalıp imgeye aykırı figürlerin öğretim ortamında yer verilmesi yaklaşımlarıyla sıkıştırılmıştır. Alan yazındaki bu tıkanmışlığı aşmanın en temel çözümü öğrencilerin bilim insanının cinsiyetine yönelik algılarını belirlemektir. Bu bakış açısıyla araştırmada "Ortaokul öğrencilerinin bilim insanının cinsiyetine yönelik algılarının kökenleri nelerdir?" sorusu hedef alınacaktır. Araştırmada ortaokul öğrencilerin bilim insanının cinsiyetine yönelik algılarının kökenleri betimlenecek ve imgeyi değiştirmeye yönelik yapılacak çalışmalara basmakalıp (maskulin) bilim insanı imgesinin nasıl ve hangi yönde revize edilmesi gerektiğine yönelik ışık tutmaya çalışılacaktır.

Belirtilen amaç çerçevesinde, ortaokul öğrencilerinin bilim insanının cinsiyetine yönelik algılarının kökenlerini belirlemek için araştırmada nitel araştırma tekniklerinden fenomenoloji yöntemi kullanılmıştır. Araştırmada fenomen olarak ele alınan bilim insanının cinsiyeti kavramına öğrencilerin yükledikleri ortak anlamlar betimlenmektedir. Araştırmaya Düzce merkez ilçede bulunan beş ortaokulda 2014-2015 öğretim yılında öğrenim gören 592 öğrenci katılmıştır. Beş okulun seçilmesinde öğretmenlerin araştırmaya verecekleri destek dikkate alınmıştır. Öğretmenlerle ön görüşmeler yapılmış ve ön görüşme sonucu araştırmaya destek veren öğretmenlerin sınıflarında uygulamalar yapılmıştır. Araştırmada öğrencilerin bilim insanının cinsiyetine yönelik algılarını belirlemek için açık uçlu sorulardan oluşan bir anket uygulanmış ve yarı yapılandırılmış görüşme düzenlenmiştir. Anket tüm öğrencilere uygulanmasına karşın, yarı yapılandırılmış görüşme grubun çok kalabalık olması nedeniyle araştırmaya katılan öğrenciler arasından rasgele seçilen 120 öğrenciyle yapılmıştır. Veri toplama araçlarından elde edilen veriler birleştirilmiş ve iki alan uzmanı tarafından içerik analizi yaklaşımı benimsenerek analiz edilmiştir. Analiz

sonucunda iki alan uzmanı tarafından verilen kodlar karşılaştırılmış ve verilen kodların 92% düzeyinde tutarlı olduğu tespit edilmiştir.

Araştırma sonucunda öğrencilerin kültürel alt yapılarının, yazılı ve görsel medyada sunulan bilim insanı figürlerinin ve toplumda bilim alanındaki uzmanları tanımlamak için "bilim adamı" kavramının kullanılmasının öğrencilerin bilim insanının cinsiyetine yönelik algılarının etkilediği bulunmuştur. Bunun yanında basılı ve görsel medyada sunulan bilim insanı figürleri ve bilim insanını tanımlamak için "Bilim İnsanı" kavramı yerine "Bilim Adamı" kavramının kullanılmasının öğrencilerin bilim insanın cinsiyetine yönelik algıları üzerine etkisi olmasına rağmen kültürün etkisinin belirtilen faktörlerden daha fazla olduğu bulunmuştur. Bu sonuç göstermektedir ki, araştırma sonuçlarında öğrencilerin bilim insanının cinsiyetine ilişkin algılarını etkileyen faktörler arasından en çok dikkati çeken öğrencilerin kültürel alt yapılarının etkisidir. Öğrencilerin kültürel alt yapılarındaki farklılık nedeniyle, bilim insanının cinsiyetine ilişkin farklı fikirler ileri sürmüşlerdir. Geleneksel kültüre sahip öğrencilerin toplumdaki basmakalıp (maskulin) erkek imgesi temelinde bilim insanının erkek olabileceğini ileri sürmüşlerdir. Toplumdaki basmakalıp bayan imgesi temelinde bilim insanını bayan olarak tanımlarken ise, toplumdaki basmakalıp erkek ve bayan imgelerini reddetmişlerdir. Ayrıca modern/batı kültürünü benimseyen öğrenciler ise bilim insanının bayan veya erkek olabileceğini ileri sürmüşlerdir. Öğrencilerin kültürel alt yapılarının onların bilim insanının cinsiyetine yönelik algıları üzerine etkisinin olması nedeniyle basmakalıp (maskulin) bilim insanı imgesinin karşıt figürlere öğretim ortamında yer verildiği mevcut yaklaşımlarla revize edilmesinin güç olduğu düşünülmektedir. Bu bakımdan ders kitaplarında bayan bilim insanı figürlerinin sayısını arttırmanın yanında, basmakalıp imgenin daha gerçekçi bir imge yönünde revize edilebilmesi için öğrencilerin geleneksel kültür temelinde benimsedikleri toplumsal cinsiyet algısını revize edecek yönde yaklaşımların işe koşulması gerekmektedir. Öğrencilerin toplumsal cinsiyet algılarını revize etmenin ise tek bir disiplinde uygulanacak bir yaklaşım değil de din kültürü ve ahlak bilgisi, sosyal bilgiler, Türkçe, resim gibi farklı disiplinlerle kaynaştırılmış disiplinler arası bir yaklaşımla gerçekleştirilebileceği düşünülebilir.