IJARE
https://dergipark.org.tr/en/pub/ij

International Journal of Academic Research in Education
Volume: 6 Issue: 1, December 2020
e-ISSN: 2149-2913
Turkish JournalPark ACADEMIC

*Preservice Science Teachers' Perceptions towards Scientists**

Merve Lütfiye ŞENTÜRK[1]
Süleyman Demirel University, Department of Educational Sciences, Isparta, Turkey

Abstract

The aim of the research is to determine the perceptions of preservice science teachers who attended the course History and Nature of Science taught according to explicit-reflective approach, towards scientists. It is also to reveal the participants' expectations from the scientists in the context of social contribution. Thus the study was planned based on qualitative phenomenological research design. Participants of the study consisted of 32 third grade preservice science teachers. Participants were provided with the necessary prerequisite knowledge through video demonstrations, questioning and answering methods, article review studies, activities related to the nature of science and sharing reflections about the activities. Data were collected using drawing technique, "A New Society" activity questions and a structured interview form. Content analysis technique was used in the analysis of the data obtained in the study. As a result of the analysis of the data, preservice teachers' perceptions about scientists were found to be compatible with the literature in terms of physical and personal characteristics, study areas, working environments and social contribution of scientists. However, contrary to the findings in the literature suggesting that the scientists are male, approximately half of the participants in this study stated that they perceived the scientists as women.

Submitted
08 December 2020

Revised
26 December 2020

Accepted
28 December 2020

Keywords:
Science, Scientists, Perception, Preservice Science Teacher, Nature of Science.

Suggested Citation:
Şentürk, M. L. (2020). Preservice science teachers' perceptions towards scientists. *International Journal of Academic Research in Education*, *6*(1), 86-99. DOI: 10.17985/ijare.837837

[1] Asst. Prof. Dr., Suleyman Demirel University, Department of Educational Sciences, Isparta, Turkey, mrvesenturk@gmail.com

* This study was presented as an oral presentation at the 28th International Conference on Educational Sciences held in 2019 in Ankara and placed in the abstract book.

INTRODUCTION

The better we know science, the better we can use it to achieve our goals determined in a systematic completeness. This process can be achieved more easily by understanding the definition of science and the characteristics of a scientist. The term "Science", which first appeared in the Middle Ages and derived from the Latin word *scientica*, means knowledge in its broadest sense, but the emergence of the term "Scientist" does not have an old history, it dates back to the nineteenth century (Angın & Özenoğlu, 2019). Science is much more complex than standard definitions. Although various explanations related to science are made, opinions regarding the lack of a clear definition of science predominate. Scientists working in different fields from many parts of the world define science in different ways on the basis of their purpose and scope (Godin, 2007). For example, for a scientist working in basic sciences, science is expressed as organizing data according to the most general and fundamental laws or qualified and stable findings (Palya, 2000). However, for a scientist from the field of social sciences, it refers to concepts and processes involved education and research processes and are patterned with scientific and technological activities (Godin, 2007). Labs, chemical reactions, physical phenomena, microscopes, telescopes, science centers, even textbooks and similar images all reflect an aspect of science, but none of them can present a complete picture in relation to science. However, in recent years, the importance of students' understanding of contemporary science has been emphasized in the reforms made in the field of science education in many countries (Lederman & Lederman, 2004). The perceptions of science and scientist develop at an early age. Thus, children's acquaintance with science at an early age affects their perspective towards science in the later years of their lives (Bartan, 2019). According to Ayvacı, Atik, and Ürey (2016), it is important to reveal how children perceive scientists in order to find out their understanding of science. Whether children will continue scientific studies in the future will be shaped as a result of these positive or negative perceptions on scientists (Finson, 2002). Children's negative perceptions about scientists and science play an important role in negatively shaping their thoughts and attitudes about scientific activities (Ayvacı, Atik & Ürey, 2016). Thus, students' positive images of the scientist is seen important (Finson, Beaver & Cramond, 1995).

Students' images of scientists are influenced by their teachers' behaviors in the teaching process (Buldu, 2006) and their expressions about scientists (Buldu, 2006; Türkmen, 2008). Therefore, the teacher's physical characteristics and behaviors in the classroom will affect the students' values and attitudes towards both science and scientists and shape the images about the scientist (Yontar Toğrol, 2013). In this direction, in order for students to have a realistic and positive image towards science and scientists, they need teachers who can provide them with accurate information and put their scientist image on a realistic basis (Çermik, 2013). Science Course Curriculum (MEB, 2017) aims to educate all individuals as science literate. To achieve this aim, helping to understand how scientists create scientific knowledge and how it is used in researches is among the objectives of the curriculum. This goal can be seen basis for formation of students' perceptions towards the scientist. Therefore, for an effective science education, it is very important to reveal how teachers perceive scientific knowledge and to gain an understanding and view of science that is valid with today's thinking (Çakıcı, 2009). In this respect, the perception of the scientist preservice teachers will develop within the scope of their education is important during the undergraduate education period when professional development is gained (Ürey, Karaçöp, Göksu & Çolak, 2017).

Learning the nature of science plays an important role in shaping preservice teachers' perception of scientists. According to Abd-El-Khalick and Lederman (2000), the approaches used in teaching the nature of science are divided into two groups as implicit and explicit-reflective direct the teaching methods and practices they use in their classes (Brickhouse, 1990). In the implicit approach, it is assumed that students can understand the nature of science by experiencing the scientific process, while in the explicit-reflective approach, students are given opportunities to question their experiences and make inferences in terms of the nature of science. The main difference between the two approaches is whether students are given the opportunity to think about the nature of science on their activities or not (Yeşiloğlu, Demirdöğen &

Köseoğlu, 2010). Khishfe and Abd-El-Khalick (2002) stated that students understand better and become more successful in teaching the nature of science on the basis of explicit-reflective approach. There are studies suggesting that methods such as conducting research and activities, giving examples, and questioning students' views on science components are more useful and effective in the process of learning the nature of science (Abd-El-Khalick, 2005; Abd-El-Khalick & Lederman 2000). For this reason, in most of the studies on the nature of science, an explicit-reflective approach has been taken as a teaching strategy (Çetinkaya, 2019).

There are many researches conducted to determine how the concept of scientist is perceived (e.g. Akçay, 2011; Ağgül Yalçın, 2012; Bilir, Eyceyurt Türk & Tüzün, 2020; Buldu, 2006; Camcı Erdoğan; 2018; Chambers, 1983; Çermik, 2013; Eyceyurt Türk & Tüzün, 2017; Fung, 2002; Huber & Burton, 1995; Kaya, Doğan & Öcal, 2008; Korkmaz & Kavak, 2010; Küçük & Bağ; 2011; Mead & Metraux, 1957; Nuhoğlu & Afacan, 2011; Özgelen, 2012; Özsoy & Ahi, 2014; Palmer, 1997; She, 1998; Song & Kim, 1999; Şenel & Aslan, 2014; Ünver, 2010; Yontar Toğrol, 2013). When these studies were examined, it was seen that before the process of determining the perceptions of students at different levels or preservice teachers, no activity or training related to the explicit-reflective approach was mentioned. Therefore, it has been inferred that many of them are based on the implicit approach of scientist perception's formation. In science education research, it is considered important to improve the conceptual perception by using appropriate methods and techniques in the teaching of scientists and the work of scientists, to facilitate students' understanding and learning of science (Schibeci, 2006; Symington & Spurling, 1990). When looking from this point of view, it is very important for science teachers to grasp the nature of science and scientific knowledge well and to transfer these concepts to their students with appropriate activities (Doğan, Çakıroğlu, Çavuş, Bilican & Arslan, 2011). In this way, it is important to ensure that preservice science teachers gain awareness by revealing their thoughts about scientists, how they perceive them, with appropriate methods and approaches. Because their perception of scientists' characteristics, which might be thought as a reflection of the components of the nature of science, is a prerequisite for the perception of the students they will train. Thus, in this study, firstly preservice science teachers were enabled to have information about scientists and to think like scientists in activities developed on the basis of an explicit-reflective approach. Then, their perceptions towards the scientist were tried to be determined.

Purpose of the study

As explained in detail in the introduction, teachers affect the perception of children about scientists. Therefore, it is important to reveal how prospective science teachers perceive scientists with appropriate methods and approaches, and if they have misperceptions about scientists, identify possible reasons for this and ensure that they gain awareness. For this reason, in this study, unlike many studies in the literature, the research was carried out after the eight-week course named the history and nature of science, taught with explicit-reflective approach. Thus the perceptions of the participants will be determined at the end of a process in which they act like scientists through questioning and research, not based on their supposed existing experiences they have.

In this regard the purpose of the research is to determine the perceptions of preservice science teachers, who attended the course *History and Nature of Science* taught with explicit-reflective approach, towards scientists. It was also aimed to reveal the expectations of participants from the scientists in the context of social contribution. *(The effect of teaching method was not investigated in the study. Only pre-service science teachers' perception of scientists was determined).*

For this purpose, the problem statement determined within the scope of the research is as follows:
What are the perceptions of preservice science teachers towards scientists?

METHOD

This qualitative research was planned based on phenomenological design. Phenomenological design aims to reveal the meanings that individuals attribute to a phenomenon about which they have knowledge and experience. For this reason, it is tried to reach the essence of the experience by questioning individuals about the phenomenon (Yıldırım & Şimşek, 2006).

Participants, Data Collection Tools and Analysis

The participants of the study consisted of 32 preservice science teachers, 2 males and 30 females, studying at the 3rd grade. In order to provide preservice teachers to have the necessary precondition knowledge for the study participating preservice teachers attended the course called History and Nature of Science, which was delivered according to explicit-reflective approach. Main components and some information on the teaching process of course named given below:

1. Lecturing, question & answer method,
2. Article review tasks,
3. Video screenings on the lives of world-renowned scientists (Einstein, Marie Cruie, Stephen Hawking, Aziz Sancar, Rosalind Franklin) and sharing of views on videos in the classroom,
4. "A New Society" activity, developed by Cavallo (2008) and used also by Yeşiloğlu, Demirdöğen & Köseoğlu's (2010) research.

5. Reflecting of opinions about the activity (Detailed information about the activity is given below).

"A New Society Activity": The activity was used in order to reveal the opinions of the participants about the characteristics of the scientist in line with their experiences. It was applied with slight changes on the basis of the characteristics of the research group. The activity involves the process of discovering by scientists a society that has its own rules and lives according to these rules. However, according to the application necessaries of the activity, scientists obtain information about the society without knowing these specific rules of the society. The rules of society are as follows:

Rule 1: Community members speak only a language made up of the words "yes" and "no".

Rule 2: If the scientist asks a question with a smile to a member of the community, whatever the question is, the answer will always be "yes", if he asks without smiling the answer will always be "no".

Rule 3: Members of the community will only answer questions posed by scientists of different sex and questions posed by scientists of their own sex only in the second round. Thus, the following steps were followed in this research:

- ✓ First, four people from among the participants were selected to form the scientist team, and they were kept outside the classroom.
- ✓ While choosing the scientist team, taking into account the rules of the society, the team was made up of scientists of different genders, smiling and sullen faces.
- ✓ The rules of the new society, which will be discovered to the participants who stayed in the classroom, were explained to them.

"Drawing", "A New Society" activity questions and "Structured Interview Form" were used as data collection tools. Activity questions were asked to the participants right after the event. The drawing and interview form were applied one week later and together. Drawing process and answers given interview questions were completed within 40 minutes.

Content analysis technique was used in the analysis of the data obtained in the study. Content analysis is a method mainly used for analyzing written and visual data (Özdemir, 2010). The main purpose of content

analysis is to reach concepts and relationships that can explain the collected data. In the analysis of the data, the themes in the literature were examined in detail, and firstly, categories related to the research subject were created, and then in the analyzed data, the frequencies of the data included in these categories were calculated. Purposeful sampling, data diversification, participant confirmation and detailed description methods were used to ensure the validity and reliability of the study.

FINDINGS

Data obtained from all data sources in the study were analyzed on the basis of the following categories:

1. Study Field of the Scientist
2. Personal Characteristics of the Scientist
3. Physical Characteristics of the Scientist
4. Gender of the Scientist
5. Working Environment of the Scientist
6. The Contribution of Scientists to Society

Findings in each category were handled separately. Participants expressed more than one opinion for each category. All of these views were reflected in the codes. For this reason, the numbers of code differ from the numbers of participants. Direct quote expressions and drawing images that support the findings in the relevant categories are as follows:

1. The Perceptions of Preservice Science Teachers about Study Fields of the Scientists

Table 1. *Study Fields of the Scientists in the Minds of Preservice Science Teachers*

Categories	Code	f
Study Field of the Scientist	Medicine	18
	Physics	11
	Biology	7
	Chemistry	5
	Astronomy	3
	Molecular Biology	1
	Pharmacology	1

According to Table 1, preservice science teachers perceive study field of scientists in seven different disciplines: "medicine, physics, biology, chemistry, astronomy, molecular biology and pharmacology". In addition, the most preferred branch of science for the field of study of the scientist was determined by the preservice teachers as medicine (f = 18) and the least preferred branches of science were molecular biology (f = 1) and pharmacology (f = 1). Example participant expressions (most and least) and visual in this category are as follows:

"My dream was to study science in the field of medicine, I wanted to include my dreams here. Because the first thing that comes to mind when I talk about the field of science is medicine…" (PT9)
"I think it includes all the sciences in medicine, for example, the working principle of the devices used in the detection of diseases such as physics, chemicals used in treatment ... Therefore, if I made a single choice as a field of study of my scientist, I would say medicine, so my scientist works in the field of medicine ..." (PT18)
"My scientist is a pharmacologist who steals more than other scientists and finds cures for all diseases ..." (PT2)

Figure 1. Example of drawing (PT2)

When the statements of the preservice teacher and the sample visual are examined, it can be inferred that they have chosen the study field that they think is respect and hard to reach.

2. The Perceptions of Preservice Science Teachers about Personal Characteristics of the Scientist

Table 2. *Personal Characteristics of the Scientist in the Minds of Preservice Science Teachers*

Categories	Code	f
Personal Characteristics of the Scientist	Patient	27
	Punctual	25
	Objective	21
	Researcher	18
	Hardworking	18
	Curious	15
	Observer	13
	Determined	10
	Interrogator	8
	Intelligent	7
	Stubborn	5
	Disciplined	4
	Intellectual	4
	Sociable	3
	Altruistic	3
	Willing to learn	3
	Tidy	3
	Open to change	3
	Helpful	2
	Sparing time for family	1

According to Table 2, preservice teachers identified twenty different personal characteristics of scientists: "patient, punctual, objective, researcher, hardworking, curious, observer, determined, interrogator, intelligent, stubborn, disciplined, intellectual, sociable, altruistic, willing to learn, tidy, open to change, helpful, sparing time for family". While the most preferred characteristics by the participants regarding the personal characteristics of the scientist are patient (f = 27), punctual (f = 25) and objective (f = 21), the least

preferred characteristics are those that allocate time for their family (f = 1) and helpful (f = 2). Example participant expressions (most and least) and visuals in this category are as follows:

"I think a scientist should be patient, just like the scientists whose life stories we see, should not be daunted by unsuccess ..." (PT5)
"If a scientist wants to be successful in his job, he must also be someone who devotes time to his family. I think this is the most important feature…" (PT17)

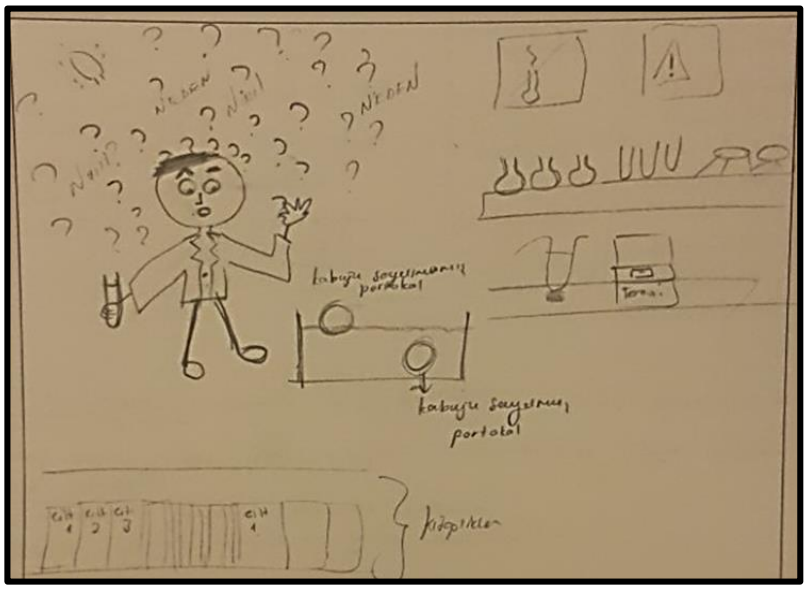

Figure 2. Example of drawing (PT5)

When the statements of the preservice teacher and the sample visual are examined, it can be stated that preservice teachers' perceptions of scientists' personal characteristics are affected by both their perspective on life and the activities in the teaching process.

3. The Perceptions of Preservice Science Teachers about Physical Characteristics of the Scientist

Table 3. *Physical Characteristics of the Scientist in the Minds of Preservice Science Teachers*

Categories	Code	f
Personal Characteristics of the Scientist	Wearing glasses	28
	Wearing apron	25
	Messy	19
	Neglected	16
	Unkempt hair	14
	Beautiful	5
	Well-groomed	4
	Bald	2
	Weak	1

According to Table 3, preservice teachers determined the characteristics of "wearing glasses, wearing apron, messy, neglected, unkempt hair, beautiful, well-groomed, bald, weak" in relation to the theme of the physical characteristics of the scientist. The most preferred features by the participants regarding the physical characteristics of the scientist were wearing glasses (f = 28) and apron (f = 25), while the least

preferred features were bald (f = 2) and weak (f = 1). Sample participant expressions (most and least) in this category are as follows:

"I cannot think of a scientist without glasses ..." (PT11)
"My scientist works so hard that he cannot even find time to eat ..." (PT19)

When the statements are examined, it can be stated that preservice teachers generally perceive that scientists wear glasses and aprons and have a messy appearance.

4. The Perceptions of Preservice Science Teachers about Gender of the Scientist

Table 4. *Gender of the Scientist in the Minds of Preservice Science Teachers*

Categories	Code	f
Gender of the Scientist	Female	16
	Male	15
	Female and Male	1

According to Table 4, it was determined that 16 of the preservice teachers were female, 15 were male and 1 had both a female and male scientist perception in relation to the gender category of the scientist. As a result of examining the data in the explanation step, it was determined that the majority of the female participants (f = 11) who drew a male scientist avoided expressing this in writing. Sample participant expressions (most and least) in this category are as follows:

"I prefer men because men are more punctual and patient ..." (PT3)
"I can say a groundbreaking woman ..." (PT23)

5. The Perceptions of Preservice Science Teachers about Working Environment of the Scientist

Table 5. *Working Environment of the Scientist in the Minds of Preservice Science Teachers*

Categories	Code	f
Working Environment of the Scientist	Equipped laboratory	22
	Library	10
	Study room	7
	Home	3
	Sky	1

According to Table 5, preservice teachers determined the environments of "equipped laboratory, library, study room, home and sky" in relation to the theme of the scientist's working environment. The most preferred place for the scientist's working environment by the participants was the equipped laboratory (f = 22), while the least preferred was the sky (f = 1). Example participant expressions (most and least) and visuals in this category are as follows:

"He is trying to find the invisibility potion in a laboratory that has everything he will need ..." (PT7)
"The home with all my experimental equipment is the best workplace. It is where scientific ideas come to mind first ..." (PT10)
"The place of scientists is the sky ..." (PT31)

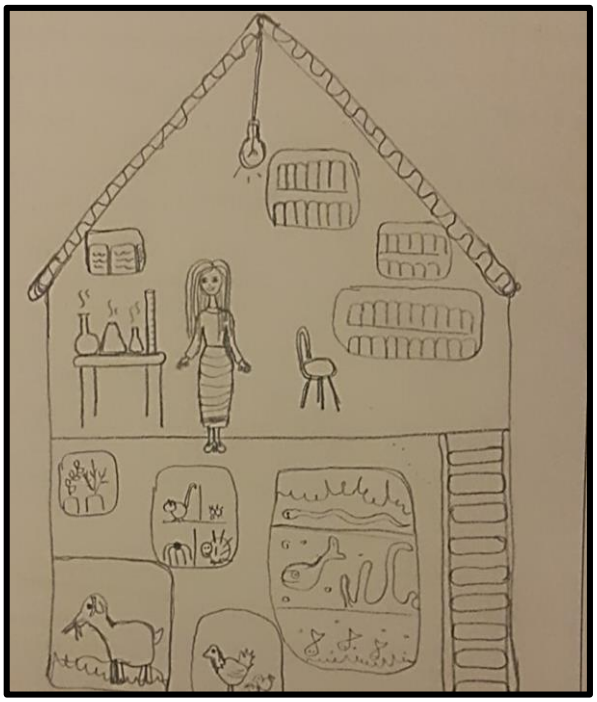

Figure 3. Example of drawing (PT10)

When the statements and the sample visual are examined, it can be stated that preservice teachers generally perceive that scientists' working environment is well equipped laboratory because of their emphasis on experimental activities.

6. The Perceptions of Preservice Science Teachers about Working Environment of the Scientist

Table 6. *Working Environment of the Scientist in the Minds of Preservice Science Teachers*

Categories	Code	f
The Contribution of Scientists to Society	Cure for cancer	23
	Cure for diseases	20
	Medicine production	16
	The invention of time machine	11
	Healthy food production	11
	Making it possible to travel to the planets	9
	The invention of the mind reading mechanism	5
	Finding the potion of invisibility	5
	Finding the energy source of black holes	4
	Improving the education system	4
	Obesity treatment	2
	Epilepsy treatment	1
	Developing tools to facilitate the life of visually impaired people	1

According to Table 6, preservice teachers stated thirteen different contribution made by the scientist to the society: "cure for cancer, cure for diseases, medicine production, invention of time machine, healthy food production, making it possible to travel to planets, invention of mind reading mechanism, Finding the

potion of invisibility, finding the energy source of black holes, improving the education system, obesity treatment, epilepsy treatment, developing tools to facilitate the lives of visually impaired people". Among these ideas, the most preferred by the participants were the cure for cancer (f = 23) and cure for diseases (f = 20), while the least preferred were epilepsy treatment (f = 1), developing a tool to facilitate the life of the visually impaired (f = 1) Obesity treatment (f = 2) was found to be. Example participant expressions and visuals in this category are as follows:

"Everyone's fearful dream is working resolutely to find a cure for cancer …" (PT25)
"My visually impaired relative came to my mind, my scientist is trying to develop a vehicle that will keep him alive under equal conditions with other people ..." (PT4)

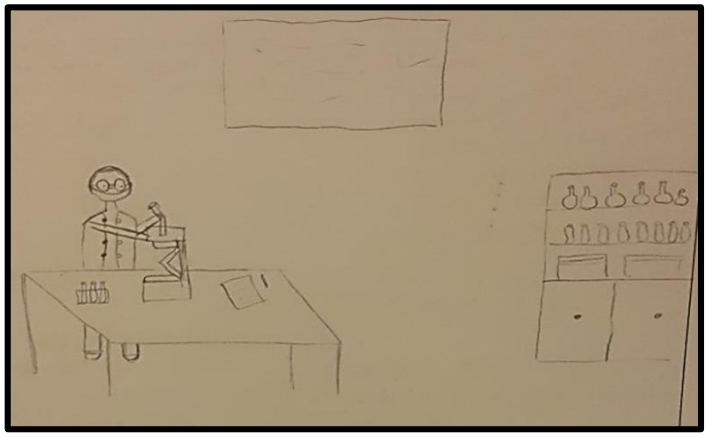

Figure 4. Example of drawing (PT25)

When the statements and the sample visual are examined, it can be stated that preservice teachers generally perceive that scientists' contribution to society is relate with diseased and they have high expectations from scientists.

DISCUSSION & CONCLUSION

As a result, it has been determined that preservice teachers perceive that scientists have better equipped, qualified and superior abilities than both themselves and many people in the society. Similar to this finding, in the literature there is the view that different perceptions about the scientist cause some student groups (such as students who think they are not very intelligent) to stay away from science and subjects related to science (Yeşiloğlu, Demirdöğen & Köseoğlu, 2010). In addition, the view that students think that they need to be very intelligent to become scientists also supports this finding (Greenfield, 1997). Preservice teachers have high expectations from scientists. This might be stem from due to their view of science as a difficult pursuit (Logan & Skamp 2005). Relating to the contributions of scientists, preservice teachers mostly put forward the views of finding cure for diseases. This finding of the research was found to be compatible with the perception that scientists identified in Şenel and Aslan's (2014) study are beneficial to society. However, there are also those who put forward ideas such as invention of some machine. This finding is similar to the tool development result in the drawings of some of the participants in research of Turgut, Öztürk and Eş (2017).

In the literature, in relation to the physical characteristics of the scientist, it is one of the features that often wearing apron, neglected, and wearing glasses. In this study, although findings of physical characteristics compatible with the literature (For example; Bartoszeck, & Bartoszeck, 2017; Bilir; Eyceyurt Türk & Tüzün, 2020; Demirbaş, 2009; Küçük & Bağ, 2011; Song & Kim, 1999; Türkmen, 2008) were reached, on the contrary, there were participants who emphasized that the scientists were well-groomed. In addition,

scientists' perceptions of their gender have been distributed in a balanced way as women and men, contrary to many previous studies in the literature (For example; Angın & Özenoğlu, 2019; Camcı Erdoğan, 2019; Çermik, 2013; Gülhan & Şahin, 2018; Mead & Metraux, 1957; Özgelen, 2012; Özsoy & Ahi, 2014; Ünver, 2010). One of the reasons for this result may be the activities that enabled the study group, 30 women, to question the characteristics of scientists in the course named history and nature of science. Similarly to this result, Deniş Çeliker and Erduran Avcı (2015) found that there is a change in favor of women in gender of scientists' perception the students who participate in activities-based science activities as a finding of their research. Consistent with the results of the research, Mason, Kahte and Gardner (1991) stated that such interventions could cause changes in students' perceptions of scientists about their gender. Since they are made to think of themselves as scientists in the activity, they may think that scientists may have the same gender as them. Therefore, it is concluded some participants have positive discrimination for the gender. Here is an expression presented within the scope of the research, in which the participants have positive discrimination, were determined in the direction of *"… I cannot say otherwise because I am a woman…", "…I think it is always a woman who solves the problem in all studies. For example, girls helped to find the characteristics of the society in our activity, so I chose a female scientist."*

One of the most common misconceptions about the nature of science in the literature, the misconception related to the objectivity of the scientist, was also detected in this study. The participants mostly defined the scientist as objective and free from prejudice. At the participant confirmation stage, it was determined that this misconception was related to determining the area for the scientist. Because they mainly associated scientists' fields of study compatible with experimental research. According to the participants systematic experimentation is important to contribute to science. Thus scientists should be objective as a requirement of this systematicity. This finding is similar to Abd-El-Khalick and Boujaoude's (1997) research results that teachers do not believe much in the creative and fanciful nature of scientific studies. Similarly, in their study Şenel and Aslan (2010) also stated that preservice teachers' perceptions of scientists' characteristics such as creativity and imagination are insufficient. As a result, the data collected after the history and nature of science course taught on the basis of an explicit-reflective teaching approach are compatible with the literature, Lederman, Abd-El-Khalick, Bell and Schwartz (2002) confirm the view that the understanding of the nature of science that the student acquired at school is in consistency with the understanding of the nature of science today. In addition, the suggestion that all students from pre-school to the end of secondary education, teacher candidates and teachers should have a consistent understanding of science can be customized also for scientist perception studies. In order to improve the perception of the scientist, it is important to understand the scientist, put himself in the place of the scientist and to think about the scientist in detail. Therefore, in order to develop positive perception, it is important to create an activity-oriented environment in which students can make inferences about these activities in teaching the nature of science. It is recommended to take this into consideration in the classroom activities.

REFERENCES

Abd-El-Khalick, F. (2005). Developing deeper understandings of nature of science: The impact of a philosophy of science course on preservice science teachers' views and instructional planning. *International Journal Science Education, 27*(1), 15-42.

Abd-El-Khalick, F., & Lederman, N. G. (2000). Improving science teachers' conceptions of nature of science: A critical review of the literature. *International Journal of Science Education, 22*(7), 665-701.

Abd-El-Khalick, F., & Boujaoude, S. (1997). An exploratory study of knowledge base for science teaching. *Journal of Research in Science Teaching, 34*(7), 673– 699.

Ağgül Yalçın, F. (2012). Öğretmen adaylarının bilim insanı imajlarının bazı değişkenlere göre incelenmesi. *İlköğretim Online, 11*(3), 611-628.

Akçay, B. (2011). Turkish elementary and secondary students' views about science and scientist. *AsiaPacific Forum on Science Learning and Teaching, 12*(1), 1-11.

Angın, D. E., & Özenoğlu, H. (2019). Öğretmen adaylarının bilim insanına ilişkin algıları. *Iğdır Üniversitesi Sosyal Bilgiler Dergisi, 18*, 255-276.

Barman, C. R. (1999). Students' views about scientists and school science: Engaging K-8 teachers in a national study. *Journal of Science Teacher Education, 10*(1), 43-54.

Bartan, M. (2019). Okul öncesi öğretmen adaylarının bilim insanı kavramlarına ilişkin metaforik algıları: Kütahya Dumlupınar Üniversitesi örneği. *Amasya Üniversitesi Eğitim Fakültesi Dergisi, 8*(2), 215-239.

Bartoszeck, A. B., & Bartoszeck, F. K. (2017). Brazilian primary and secondary school pupils´ perception of science and scientists. *European Journal of Educational Research, 6*(1), 29-40.

Bilir, V., Eyceyurt Türk, G., & Tüzün, Ü. (2020). Öğretmen adaylarının Kimya alanında çalışan bilim insanı imajları ve bu imajları etkileyen faktörler. *Trakya Eğitim Dergisi, 10*(1), 76-91.

Brickhouse, N. W. (1990). Teachers' beliefs about the nature of science and their relationship to classroom practice. *Journal of Teacher Education, 41*, 53–62.

Buldu, M. (2006). Young children's perceptions of scientists: A preliminary study. *Educational Research, 48*(1), 121-132.

Camcı Erdoğan, S. (2018). Üstün zekâlılar öğretmenliği adaylarının gözlerinden bilim insanları. *YYÜ Eğitim Fakültesi Dergisi (YYU Journal of Education Faculty), 15*(1), 130-155.

Camcı Erdoğan, S. (2019). How do prospective elementary and gifted education teachers perceive scientists and distinguish science from pseudoscience? *Journal of Education in Science, Environment and Health (JESEH), 5*(1), 119-133.

Cavallo, A. (2008). Experiencing the nature of science: An interactive, beginning of semester activity. *Journal of College in Science Teaching*, 12-15.

Chambers, D. W. (1983). Stereotypic images of the scientist: the draw- a scientist test. *Science Education, 67*(2), 255-265.

Çakıcı, Y. (2009). Fen eğitiminde bir önkoşul: Bilimin doğasını anlama. *M.Ü. Atatürk Eğitim Fakültesi Eğitim Bilimleri Dergisi, 29*, 57-74.

Çermik, H. (2013). Öğretmen adaylarının zihinlerinde canlanan resimdeki bilim insanı. *Pamukkale Üniversitesi Eğitim Fakültesi Dergisi, 33*(1), 139-153.

Demirbaş, M. (2009). The relationships between the scientist perception and scientific attitudes of science teacher candidates in Turkey: A case study. *Scientific Research and Essay, 4*(6), 565-576.

Deniş Çeliker, H., & Erduran Avcı, D. (2015). İlkokul öğrencilerinin bilim insanı algıları: öğrencilerin bilimsel faaliyetlere katılması bilim insanı algılarını nasıl etkiler? *Mehmet Akif Ersoy Üniversitesi Eğitim Fakültesi Dergisi, 36*, 90-104.

Doğan, N., Çakıroğlu, J., Çavuş, S., Bilican, K., & Arslan, O. (2011). Öğretmenlerin bilimin doğası hakkındaki görüşlerinin geliştirilmesi: Hizmetiçi eğitim programının etkisi. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi, 40*, 127-139.

Eyceyurt Türk, G., & Tüzün, Ü. N. (2017). Lise öğrencilerinin bilim insanı imajları ve bilimin doğası mitleri. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi ,18*(2), 19-36.

Finson, K. D. (2002). Drawing a scientist: What we do and do not know after fifty years of drawings. *School Science and Mathematics, 102*, 335-346.

Fung, Y. Y. H. (2002). A comparative study of primary and secondary school students' images of scientists. *Research in Science and Technological Education, 20*(2), 199-213.

Godin, B. (2007). *Project on the History and Sociology of S & T Statistics*. (Working Paper No: 35). Accessed from: http://www.csiic.ca/PDF/Godin_35.pdf.

Greenfield, T. A. (1997). Gender-and grade-level differences in science interest and participation. *Science Education, 81,*259-277.

Gülhan, F., & Şahin, F. (2018). Ortaokul 5. ve 7. sınıf öğrencilerinin mühendisler ve bilim insanlarına yönelik algılarının karşılaştırmalı olarak incelenmesi. *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi, 12*(1), 309-338.

Huber, R. A., & Burton, G. M. (1995). What do students think scientists look like? *School, Science and Mathematics*, *95*(7), 371–376.

Kaya, O. N., Doğan, A., & Öcal, E. (2008). Turkish elementary school students' images of scientists. *Eurasian Journal of Educational Research, 32,* 83-100.

Khishfe, R., & Abd-El-Khalick, F. (2002). The influence of explicit and reflective versus implicit inquiry-oriented instruction on sixth graders' views of nature of science. *Journal of Research in Science Teaching, 39*(7), 551–578.

Korkmaz, H., & Kavak, G. (2010). Primary school students' images of science and scientists. *Elementary Education Online, 9*(3), 1055-1079.

Küçük, M., & Bağ, H. (2011). 4 ve 5. sınıf öğrencilerinin bilim insanı imajlarının karşılaştırılması. *Bayburt Üniversitesi Eğitim Fakültesi Dergisi, 7*(2), 125-138.

Lederman, N. G., Abd-El-Khalick, F., Bell, R. L., & Schwartz, R. S. (2002). Views of nature of science questionnaire: Toward valid and meaningful assessment of learners' conceptions of nature of science. *Journal of Research in Science Teaching, 39*(6), 497–521.

Logan, M., & Skamp, K. (2008). Engaging students in science across the primary secondary interface: Listening to the students' voice. *Research in Science Education, 38*(4), 501– 527.

Mason, C. L., Kahte, B., & Gardner, A. L. (1991). Draw-A-Scientist: Future implications. *School Science and Mathematics, 91*, 193-198.

Mead, M., & Metraux, R. (1957). Image of the scientist among high-school students. *Science, 126*(3270), 384– 390.

Milli Eğitim Bakanlığı (MEB) (2017). Fen bilimleri dersi öğretim programı, (İlkokul ve ortaokul 3, 4, 5, 6, 7 ve 8. sınıflar). Ankara: Milli Eğitim Basımevi.

Nuhoğlu, H., & Afacan, Ö. (2011). İlköğretim öğrencilerinin bilim insanına yönelik düşüncelerinin değerlendirilmesi. *Ahi Evran Üniversitesi Eğitim Fakültesi Dergisi, 12*(3), 279-298.

Özdemir, M. (2010). Nitel veri analizi: Sosyal bilimlerde yöntembilim sorunsalı üzerine bir çalışma. *Eskişehir Osmangazi Üniversitesi Sosyal Bilimler Dergisi, 11*(1), 323- 343.

Özgelen, S. (2012). Turkish young children's views on science and scientists. *Educational Sciences: Theory & Practice, Special Issue*, 3211-3225.

Özsoy, S., & Ahi, B. (2014). Çocukların gözüyle "bilim insanı". *Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Dergisi, 8*(1), 204-230.

Palmer, D. H. (1997). Investigating students' private perceptions of scientists and their work. *Research in Science & Technological Education, 15*(2), 173-183.

Palya, W. L. (2000). *The logical foundations of psychology. Research Methods Lecture Notes*. USA, Jacksonville State University. Accessed from: http://www.jsu.edu/depart/psychology/sebac/fac-sch/rm/Ch1-1.html.

Schibeci, R. (2006). Student images of scientists: What are they? Do they matter? *Teaching Science, 52*(2), 12-16.

Şenel, T., & Aslan, O. (2014). Okul öncesi öğretmen adaylarının bilim ve bilim insanı kavramlarına ilişkin metaforik algıları. *Mersin Üniversitesi Eğitim Fakültesi Dergisi, 10*(2), 76-95.

She, H. C. (1998). Gender and grade level differences in Taiwan students' stereotypes of science and scientists. *Research in Science & Technological Education, 16*(2), 125-135.

Song, J., & Kim K. (1999). How Korean students see scientists: the images of the scientist. *International Journal of Science Education, 21*(9), 957-977.

Symington, D. & Spurling, H. (1990). The 'draw a scientist test': interpreting the data. *Research in Science & Technological Education, 8*(1), 75–77.

Turgut, H., Öztürk, N., & Eş, H. (2017). Üstün zekâlı öğrencilerin bilim ve bilim insanı algısı. *Abant İzzet Baysal Üniversitesi Eğitim Fakültesi Dergisi, 17*(1), 423-440.

Türkmen, H. (2008). Turkish primary students' perceptions about scientist and what factors affecting the image of the scientists. *Eurasia Journal of Mathematics, Science and Technology Education, 4*(1), 55–61.

Ünver, A. O. (2010). Perceptions of scientists: A comparative study of fifth graders and fourth year student teachers. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 4*(1), 11-28.

Ürey, M., Karaçöp, A., Göksu, V., & Çolak, K. (2017). Fen ve sosyal bilimler kökenli öğretmen adaylarının bilim insanı algıları. *YYÜ Eğitim Fakültesi Dergisi (YYU Journal of Education Faculty*), *14*(1),205-226.

Yeşiloğlu, S. N., Demirdöğen, B., & Köseoğlu, F. (2010). Bilimin doğası öğretiminde ilk adım: Yeni toplum etkinliği ve uygulanışı üzerine tartışmalar. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi, 11*(4), 165-188.

Yıldırım, A., & Şimşek, H. (2006). *Sosyal Bilimlerde Nitel Araştırma Yöntemleri* (5. Baskı). Ankara: Seçkin Yayınları.

Yontar Toğrol, A. (2013). Turkish students' images of scientists. *Journal of Baltic Science Education, 12*(3), 289-298.