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Determination of Academics' Mental Models About Science, Scientists, and Perceptions of Scientific Development

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Abstract

Purpose: This research aimed to determine the academics' mental models about science, scientists, and perception of scientific development.

Method: The survey method was used in the research. The participants of the study are a total of 112 academics with different academic titles working in universities in seven different regions of Turkey, which include the faculties of health sciences, social sciences, natural sciences, and educational sciences. The study used an interview form consisting of 6 questions developed by the researchers as a data collection tool. The data obtained from the corresponding form were transcribed and analyzed in NVivo 9.0.

Results and Conclusion: When the data obtained from the participants are evaluated; (i) academics frequently use the definitions in scientific books when defining the concept of science, (ii) there is an effect of the department variable and popular events studied in their thoughts on the concept of scientist, (iii) there are differences in their perceptions of the development of science between the areas where development is expected worldwide and the areas where change is expected in Turkey. Depending on the results obtained, implications were presented to academics and researchers who want to conduct research in the subject area.

Keywords: Academics, mental model, science, scientist, scientific development

Akademisyenlerin Bilim, Bilim İnsanı ve Bilimsel Gelişim Algılarına İlişkin Zihinsel Modellerinin Belirlenmesi

Öz

Amaç: Bu araştırmada akademisyenlerin bilime, bilim insanlarına ve bilimsel gelişme algısına ilişkin zihinsel modellerini belirlemeyi amaçlamıştır.

Yöntem: Araştırmada tarama yöntemi kullanılmıştır. Araştırmanın katılımcılarını Türkiye'nin yedi farklı bölgesindeki sağlık bilimleri, sosyal bilimler, fen bilimleri ve eğitim bilimleri fakültelerinde görev yapan farklı akademik unvanlara sahip toplam 112 akademisyen oluşturmaktadır. Araştırmada veri toplama aracı olarak araştırmacılar tarafından geliştirilen 6 sorudan oluşan görüşme formu kullanılmıştır. İlgili formdan elde edilen veriler, NVivo 9.0 programına aktarılmış ve analiz edilmiştir.

Bulgular ve Sonuç: Katılımcılardan elde edilen veriler değerlendirildiğinde; (i) akademisyenlerin bilim kavramını tanımlarken bilimsel kitaplardaki tanımları sıklıkla kullandıkları, (ii) bilim insanı kavramına yönelik düşüncelerinde görev yaptıkları bölüm değişkeni ile popüler olayların etkisinin olduğu ve (iii) Bilimin gelişimine yönelik Dünya çapında gelişme beklenen alanlar ile Türkiye'de gelişme beklenen alanlar arasında farklılıkların olduğu ortaya konulmuştur. Elde edilen sonuçlara bağlı olarak konu alanında araştırma yapmak isteyen akademisyen ve araştırmacılara öneriler sunulmuştur.

Anahtar Sözcükler: Akademisyen, zihinsel model, bilim, bilim insanı, bilimsel gelişim

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INTRODUCTION

The duration of a science term is the time it takes to find solutions to problems that arise in everyday life. It is rising the products that obtain favor for humans at the end of this period (Flick & Lederman, 2006). Though science is stated in general, it is difficult to define conceptually and procedurally because it is used in so many sectors such as engineering, health, and education. In this complex case, many views, such as creating knowledge, respecting scientific information, building on epistemological footing, and scientists' perceptions, are used to define science (McComas, 2002). Albert Einstein's science is characterized as enabling compatibility efforts between various sensory facts devoid of many orders and proper thoughts (Holton, Galison, & Schweber, 2008). Otherwise, Bertrand Russell defines science as an attempt to discover the law by observation and observational reasoning (Russell, 1998). According to the Turkish Language Society (2018), science is a term that refers to interrogating the cosmos or occurrences as part of a systematic research process aimed at reaching a result using methods and reality based on scientific experimentation. When the definitions are considered, science has a framework that can arise and evolve with thoughts, observations, and experiments. Ultimately, science is a phenomenon that originates from people's curiosity, assists them in improving their living situations, discovers unknowns, and is continually evolving (Matthews, 2012).

The concept of science has significant implications for human life, raising people's living standards by instilling a feeling of curiosity in them (McComas, 2002). Therefore, some people have been drawn to this profession and have begun to work in it. As a result of these advances, the term "scientist" was coined. Scientists are those who understand how to get information by utilizing the science and its products to obtain the most correct information, analyze that information, keep up with new scientific advancements, and apply science in their daily lives (Kara, 2013). It has become necessary to work on the topic area due to the scientific, economic, and social values of the concept of science and scientist. For this reason, it is necessary to define the mental models of people for the concept of science and scientist (Engineering and Public Policy Committee on Science, 2009).

What does it mean to have a scientific image?

The physical, mental, and characteristic portrayal that comes to his/her eyes when he/she imagines a scientist can be defined as the impression that the individual develops in his/her mind about the scientist. Individuals must have experienced specific preliminary experiences relating to the image of a scientist to design one in their imaginations. These encounters can take the form of seeing a scientist's picture, reading a book's depiction of a scientist, watching a re-enactment or video about a scientist, meeting a scientist, or hearing others' accounts of a scientist. From this perspective, various external conditions have an impact on the images of scientists generated in individuals (Engineering and Public Policy Committee on Science, 2009). Schibeci, Webb, Robinson, and Thorn (1986) express that media and television play a significant part in the stereotyping of images made for scientists in their study. Yontar-Togrol (2000) claims that the media's influence on the stereotyping of scientist pictures is undeniable. Many scientists have attempted to determine the image of pupils toward scientists, including Chambers (1983), and Mead and Metraux (1957). First studies on the determination of images for science and scientist, Mead and Metraux found positive and negative aspects of scientists' images in their renowned experiment with high school students in the United States.

Positive Images

1. The scientists are genius and put in a lot of effort for science.

2. The scientists are cautious, hardworking, patient, fearless, and open-minded. Moreover, they are universally minded, comprehensive, morally copyrighted, and enlightened people.

3.Even if scientists fail in their studies, they never give up. They continue to carry out their work.

4.The scientists work for the good of their nation, not for the sake of money or fame.

5.The scientists are genuinely remarkable individuals, and the future rests on their shoulders.

6. Scientists follow new developments in science and technology and can use technology in their daily life.

Negative Images

1. When conducting research, scientists think a lot about everything, but it's not significant thinking and the scientific topic in which scientists works is uninteresting, tedious, and boring.

2. The scientists are on their own if they do their work alone, and the financial weight of their research is significant.

3. Scientific study has the potential to be hazardous. The chemicals it works with might explode or be harmed by radiation exposure.

4. Scientists have become so engrossed in their job that they are completely unaware of what is going on around them.

5. It has the potential to compel your children to choose careers as scientists.

6. Most scientists aren't married because no one wants to marry someone like that.

Concordantly when the literature is examined, the images of studies about the opinions and thoughts of kindergarten students (Can, Yildiz-Demirtas, & Altun, 2017; Eckhoff, 2017; Lee, 2010; Ozel, 2012), primary school students (Agranovich & Assaraf, 2013; Cermik & Fenli-Aktan, 2020; Emvalotis & Koutsianou, 2017; Fung, 2002; Monhardt, 2003), middle school students (Fung, 2002; Gibson & Chase, 2002; Koren & Bar, 2009; Medina-Jerez, Middleton, & Orihuela-Rabaza, 2011; Ruiz-Mallén & Escalas, 2012; Scherz & Oren, 2006; Yvonne, 2002), high school students (Bennett & Hogarth, 2009; Scherz & Oren, 2006; Singh, 2015; Taylor et all., 2022), university students (Chittleborough, Treagust, Mamiala, & Mocerino, 2005; Miele, 2014; Provost et all., 2011; Rizk, Jaber, Halwany, & BouJaoude, 2012) about science and scientists were found. When looking at studies on this topic, however, there is not enough work on academics' opinions and perceptions on the subject. Whereas the views and opinions of academics in universities, expressed as a field of competence in the production and use of science, are extremely important. In this regard, the goal was to find out what university academics thought about mental models of science and scientists, as well as the progress of science. For the related purpose, the main questions of "*What are the mental models of academics about science and scientists?*" and "*What are the perceptions of academics about the development of science?*" have been emphasized. Accordingly, academics' opinions about the concept of science, the occurrence process, the product revealed by science, the scientific concept, the development of science in the world, and the development of science in Turkey, have been examined.

The Aim of the Study

This research aimed to determine the academics' mental models about science, scientists, and perception of scientific development.

Research Questions

The main problem situation of this research is *"What are the academicians' thoughts on science, scientists, and scientific development?".* Depending on this main problem situation, the sub-problem situations are as follows:

1. "How do you define the concept of science?" and "What do you think about the concept of science?"
2. "How do you think science emerged?" and "What are the factors affecting the emergence of science?"
3. "What are your thoughts about the products that science has created?" and "Can you illustrate your thoughts about scientific products?"
4. "Who is called the scientist and what kind of features does it have?" and "When you are called a scientist, who is the first person to come to your mind and why does this person come to your mind?"
5. "In which fields, science is developing worldwide?"
6. "In which fields, science is developing in our country?"

METHOD

Research Design

This research aimed to determine the academics' mental models about science, scientists, and perception of scientific development. For this purpose, the survey method as a qualitative approach has been preferred. The survey method can be explained as studies in which qualities such as opinions-interests-skills-attitudes of individuals on any subject are investigated by describing them by measuring them with a single application. If the

purpose of research is to make a description by taking a picture of the current situation related to the research subject, the most appropriate research method is the survey method (Grovers et all., 2011).

Participants of the Study

The participants of the research were from Turkey's seven regions (Marmara, Black Sea, Aegean, Central Anatolia, Mediterranean, Eastern, and South-eastern Anatolia), and have been selected among the academics performing their studies as academics in four different fields of health sciences, social sciences, natural sciences, and education sciences. It consists of a total of 112 personnel, 1 from the academic level/title and 16 from each university. In the selection of such universities and academics; the simple random sample selection technique was preferred considering the applicability of the research, it executes ability and the representation of the universe. Simple random sample selection is a method in which everyone has the same chance of being chosen and thus increases the probability of representing the universe (Creswell & Cresswell, 2017). By the ethical rules, the participants have been coded as A1, A2, …, and A112. Qualitative information about the participants is presented in Figure 1.

Figure 1. The Qualitative Information about the Participants

Marmara	Black Sea	Aegean	Central Anatolia
Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.

East Anatolia	Mediterranean	Southeastern Anatolia	TOTAL
Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Health Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Health Sciences (28) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Social Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Social Sciences (28) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Natural Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Natural Sciences (28) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.
Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Educational Sciences (4) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.	Educational Sciences (28) Res. Ass. / Asst. Prof. / Assoc. Prof. / Prof. Dr.

Data Collection Tool

The study was carried out 6-question interview form developed by the researchers has been used in the study. While the questions have been composed, it has been attentive to representing the purpose of the research and the problem situations and it has taken the advantage of experts and field writing.

The data collection process of the research was carried out with an interview form consisting of 6 questions created by the researchers. The interview form was transferred to the online platform via "Google Form" and the participants were asked to fill in the form consisting of 6 questions. By the ethical rules in the research, only the academic titles and regional variables were requested from the demographic information of the participants. It was also stated that they would be coded and included in the scope of the research by law on the protection of personal data. After analyzing the data obtained from the participants, findings for the research were created.

Data Analysis

The data obtained from the structured interviews with the participants of the study were analyzed using the NVivo 9 Program. The presence of the codes in the qualitative data was determined by the data gotten by the transcription, obtained with the help of the voice recorder. The content analysis process in which the themes were created, and the inferences were made was performed by putting these codes together (Seers, 2012; Thorne, 2000).

Credibility and Consistency

For the credibility factor, the long-term interactions, the confirmations of participants, and the opinions of experts are the most common applications. In long-term interaction, remaining the researchers in the search area as much as possible ensures the elimination of prejudices and the recognition of the culture of the research environment (Jha, 2008). To solve such problems, the study can be carried on by the confirmation of participants. Within the scope of the research, long-term interaction and participant confirmation criteria have been taken into consideration. In the studies, for the consistency factor, the compatibility factor of the analysis made by the different researchers and if the applications are repeated or not repeated are taken into consideration (Lincoln & Guba, 1985). Within the scope of the research, academics' answers to interview questions for the theme of consistency have been classified separately by the researchers. By the comparison of these categories, it was tried to be consistent with the compatibility between independent observers.

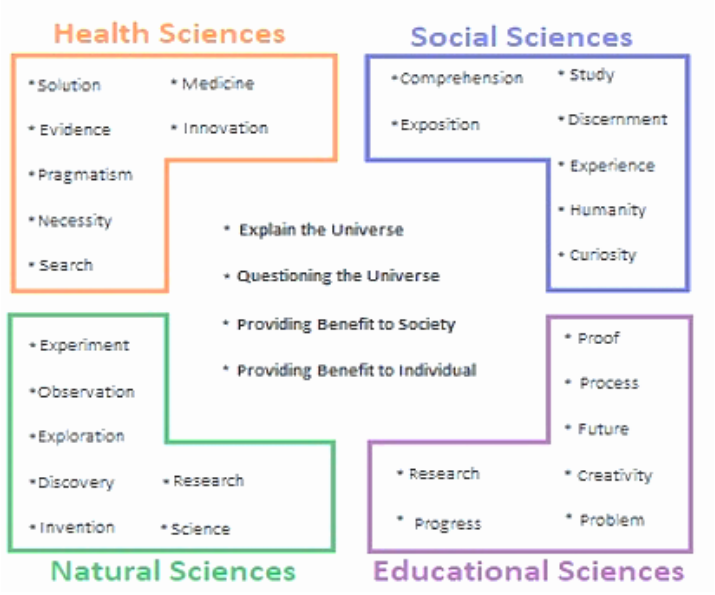
Research Ethics

To carry out the data collection process in the research, the Social and Human Sciences Scientific Research and Publication Ethics Committee of the university was applied, and the necessary approvals were obtained. In addition, by the ethical rules in the research, the participants were expressed with codes.

FINDINGS

According to the subject of the research, the findings obtained from the answers of the participants in the structured interviews were divided into six themes as the sub-problems of the study. As the first theme of the study, the questions "*How do you define the concept of science?*" and "*What do you think about the concept of science?*" are asked of academics about the concept of science. The data obtained from the participants are presented in Figure 2.

Figure 2. The Views of Academics about the Concept of Science



When examining Figure 2, it is seen that there are similarities and differences between the views of academics in preferred participant groups regarding the 'science' term. The common characteristics of the participant groups regarding the concept of science are seen being combined with their efforts to explain and question the universe and to benefit the individual and society.

• A44 coded participant verbalizes his/her opinion that science is an attempt to **explain and question the universe**, as *"Science is a concept that explains the reasons for the events occurring in the universe, bases these reasons on scientific facts, and emerges products"* and A21 coded participant verbalizes it as "*Science is the observations and experiments that people have in an attempt to understand the nature and to investigate the causes of occurrence of the events*".

• A12 coded participant saying science is based on **providing benefit to society and the individual** has been explained that "*Science provides benefits to individuals and then to the societies that individuals come together with*". A03 coded participant described as "*Science has emerged in line with individual or social needs and the solutions put for this concept, directly affect the needers*".

Differences between science concepts, in terms of participating groups as health scientists, have been found as 'evidence, necessity, and innovation'. For the variables of evidence, necessity, and innovation in the data obtained from health scientists, A07 coded participants' opinions that science is the structure that has been revealed in the subjects they need.

• A07 coded participant stated his opinion about '**evidence, necessity and innovation**' variables in data obtained from health scientists have defined as "*Science is the structures that have been revealed in the subjects that people need. The evidence factor plays an important role in the adoption of these structures as science*".

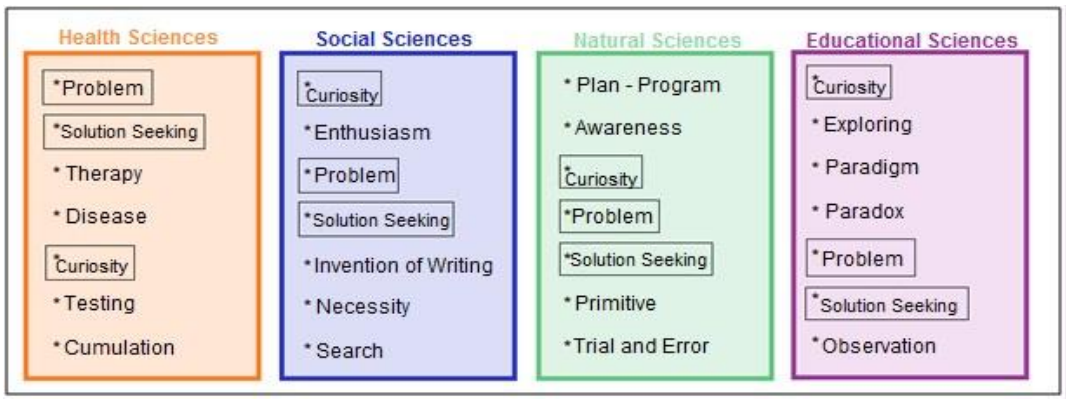
• For social scientists, differences in science are found as 'experience, comprehension, and curiosity. In the data obtained from social scientists, according to variables such as '**experience, comprehension and curiosity**', A14 coded participant described his/her opinion as "*Science is evaluated within the 'reasoning and research cycle. This concept is the process of conducting the process by individuals' competencies or researches when they are not enough with their experiences"*.

• According to the perspective of natural scientists, science-related differences are found as 'experiment, observation, and invention'. For variables in the data obtained from scientists reported as '**experiment, observation, and invention**', A23 coded participant described his/her opinion as "*Science is the name given to the information obtained because of examination using experiments and observations in nature, with the idea of providing social benefit"*.

• According to the obtained data, science finds its place in circulation such as through discovery and invention.' From the point of view of educational scientists, the differences related to a science show variations such as 'proof, process, and problem'. For variables in the data obtained from educational scientists that were reported as '**proof, process and problem**', A31 coded participant verbalized his/her opinion as "*It is the whole of the methods that individuals have chosen in the process to find solutions to the problems they face in daily life*".

As the second theme of the research, the questions "How do you think science emerged?" and "What are the factors affecting the emergence of science?" are asked of academics about the **emergence of science**. The data obtained from the participants are presented in Figure 3.

Figure 3. The Views of Academics about the Emergence of Science



As stated in Figure 3, it is seen that the opinions of academics about the emergence of science are gathered under two headings as identical and different codes between health sciences, social sciences, natural sciences, and educational sciences. The identical codes of the participant groups for the emergence of science are "**problem, solution seeking, and curiosity**". Different codes for the emergence of the science indicated by social scientists are found as the invention of writing and necessity.

- In the field of social sciences, the A57 coded participant, who works as an academic, expressed his/ her opinion on the emergence of science as "*In terms of science, the discovery of writing has been very important. People were able to understand science, do research, and demonstrate similarities and differences between their requirements and the needs of other societies*".

Different codes for the emergence of the science mentioned by health scientists are "disease and testing".

- In the field of health sciences, the A35 coded participant, who works as an academic, described his/ her opinion on the emergence of science as "*There are two important mottoes in the emergence of science. First, people seek solutions to the diseases or problems they have encountered. The second is their desire to learn about the subjects they are curious about. Solving the problem by carrying on studies and accumulation of tests by performing tests is the basis of science*".

Different codes for the emergence of the science mentioned by natural scientists are '**primitive and trial & error**'.

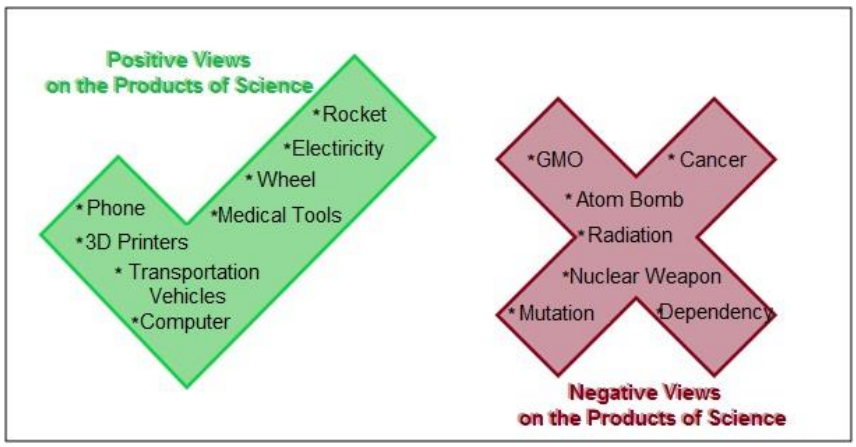
- In the field of natural sciences, the A49 coded participant, who works as an academic, described his/ her opinion on the emergence of science as "*Science has come to the present day from primitive men, whom we call humanity's beginning. Primitive man wondered about the environment, nature, objects, and sky. These feelings of curiosity have caused them to encounter various problems or insufficiencies*".

Different codes for the emergence of the science described by educational scientists are '**paradox and paradigm**'.

- In the field of educational sciences, the A63 coded participant, who works as an academic, mentioned his/ her opinion on the emergence of science as "*Science is the process of solving the problems within the frame of human beings' efforts to make sense of the environment depending on the curiosity. In this process, the contribution of the paradoxes, which are called a set of ideas that cannot be solved within them, is very important with the influence of the paradigms that dominate in a certain period*".

The third theme of the research asked the academics about the products produced by science "What are your thoughts about the products that science has created?" and "Can you illustrate your thoughts about scientific products?". The data obtained from the participants are presented in Figure 4.

Figure 4. The Views of Academics about the Products of Science



As outlined in Figure 4, it is seen that the opinions of academics about the products produced by science are divided into two headings positive and negative. Positive views on the products of science, phone, 3D printers, vehicles, computers, medical tools, wheels, electricity, and rocket are shown with examples under eight sub-

headings. Negative views on the products of science are expressed under seven sub-headings as GMO (Genetically Modified Organism), the atomic bomb, radiation, nuclear weapon, mutation, dependency, and cancer.

- A11 coded participant described his/her opinion as positively, the products of science as **phones, 3D printers, and computers**, mentioned that "*Science started with the phone, for me. It's a dream to be on the other side of the line by dialing the keys and being able to talk through the connections, isn't it? The emergence of the computers where we moved our communication activities to the summit should have been an event that stepped into a new age. No longer then, functions that you can perform via the computer can also perform via the phone. While I was thinking 'Let's see what will come out soon, I came across this time, with 3D printers*".

As positively,

- A52 coded participant described his/her opinion, the products of science as '**the wheel, vehicles, and rocket**', mentioned that "*The wheel is the most important invention. Considering the conditions of the period, the formation of a smooth rolling structure, then transporting it to the vehicles, was important. There is a kinship between the first wheel silhouettes and those preferred today. This development has influenced many means of transportation, from car to train, from train to aircraft, and perhaps even as a starting point for rockets*".

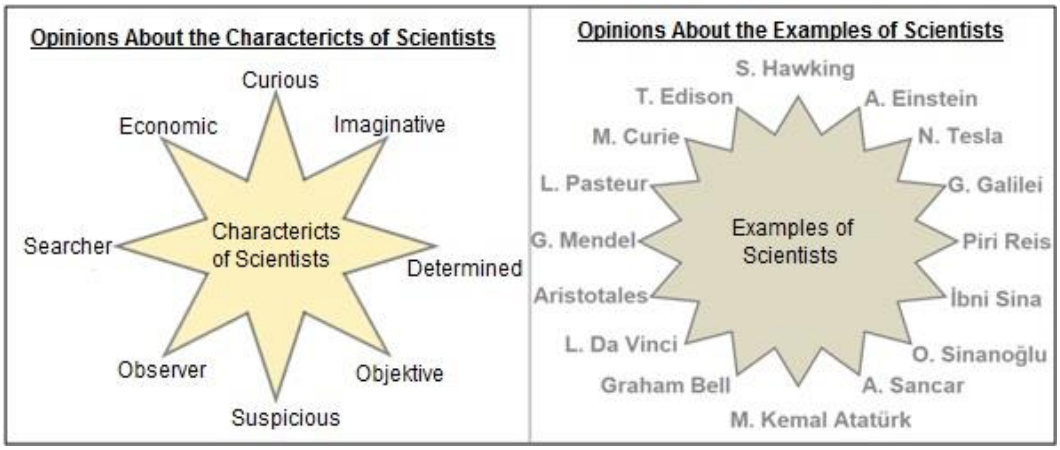
- A29 coded participant described his/her opinion as positive, the products of science as '**medical tools and electricity**' and mentioned that "*Ultrasound devices, positron emission tomography instruments, and anesthesia equipment are important structures for the prevention and treatment of diseases. Considering the change and development of these structures from past to present, it is possible to see positive developments*". As negatively,

- A42 coded participant described his/her opinion, the products of science as '**atom bomb, nuclear weapon, radiation, and cancer**', mentioned that "*Although the importance of science and its benefits for the people are mentioned, the atomic bombs sent to Hiroshima and Nagasaki, the radiation emitted by technological devices and instruments, and consequently the increase in cancer rate worldwide, are the topics that need to be considered and emphasized*".

- A39 coded participant described his/her opinion as negatively, the products of science as **GMO, mutation, and dependency,** mentioned that "*The fact that genetically modified nutrients entered our cabinets led to the incidence of mutated births. Missing-toed babies, conjoined twins, children without any limbs, and more … The news of the deaths of young people, who are addicted to technology because of the games they play or their desire to become popular, will be sufficient to explain the negative aspect of science*".

The fourth theme of the research was asked the academics about 'the scientist term' as "Who is called the scientist and what kind of features does it have?" and "When you are called a scientist, who is the first person to come to your mind and why does this person come to your mind?". The data obtained from the participants are presented in Figure 5.

Figure 5. The Views of Academics about the Concept of Scientists



As illustrated in Figure 5, the views of academics on the concept of scientists are gathered under two different headings: the characteristics of the scientist and the scientists. Participants expressed the characteristics they possessed in fewer than eight sub-headings: 'curious, imaginative, determined, objectivity, suspicious, observer, searcher, and being economic'. The sample models of the participants for the concept of the scientist are S. Hawking, A. Einstein, N. Tesla, G. Galilei, Piri Reis, Ibn Sina, O. Sinanoglu, A. Sancar, M. Kemal Ataturk, Graham Bell, L. Da Vinci, Aristotle, G. Mendel, L. Pasteur, M. Curie, and T. Edison, are described under 16 headings.

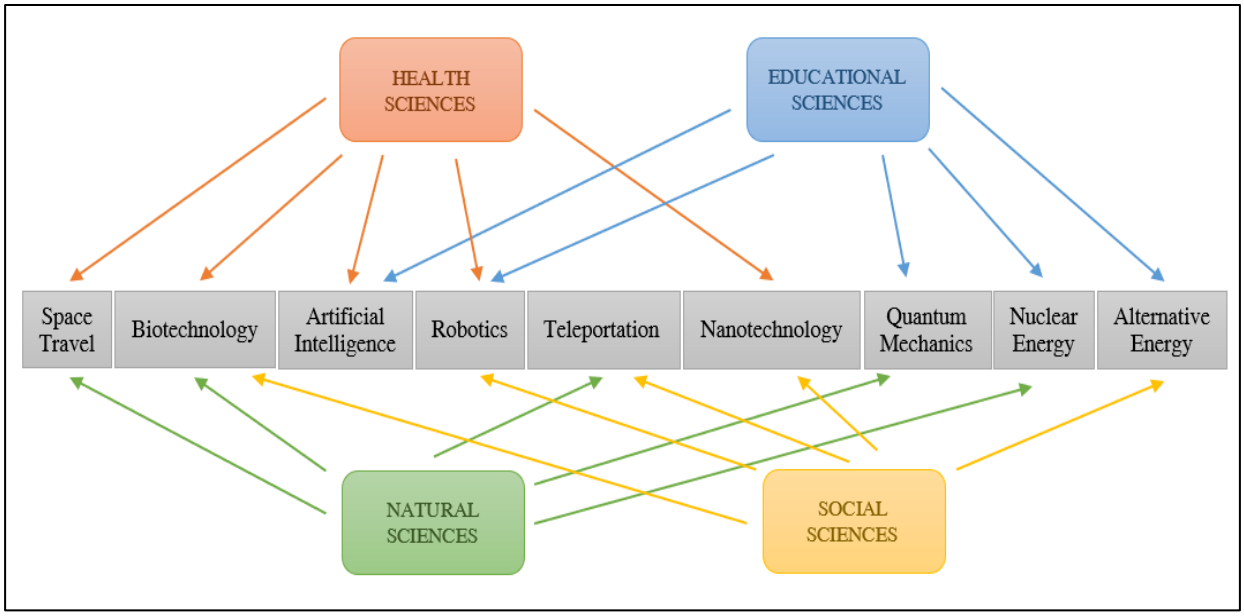
- Participant A09 who mentioned the **'curious, determined, suspicious and observer'** factors for the characteristics of the scientists, described his/her opinion as: "*People who work with science if they are kneaded by the philosophy of the work, underneath, 'curiosity against the environment and nature, the causes and consequences of the events in the environment and nature, taking into account the question of inquiry and reversibility, taking into account is based on the approach by suspicion*".

- A54 coded participant, referring to the factors, '**observer, determined and objective**' for the characteristics of the scientists, expressed his/her opinion as: "*Scientists should be good observers. However, observation alone will not be sufficient. It is necessary to be persevered to start and finish the research, regardless of what reason, not to leave the job, and to look at the events objectively, even if it contradicts their thoughts*".

- A61 coded participant, referring to the **'imaginative and economic'** factors for the characteristics of the scientists, stated his/her opinion as, "*Scientists are imaginative. They can use their imagination to look at events from different perspectives and see things that nobody has ever seen before. This situation causes us to gain an advantage in time and cost*".

The fifth theme of the research was asked the academics about 'the development of science on earth' as, "In which fields, science is developing worldwide?". The data obtained from the participants are presented in Figure 6.

Figure 6. *The Views of Academics about the Development of Science in the World*



As Figure 6 demonstrates, the views of academics on the development of science in the world are gathered under nine different headings: quantum mechanics, nuclear energy, teleportation, biotechnology, robotics, alternative energy, nanotechnology, artificial intelligence, and space travel.

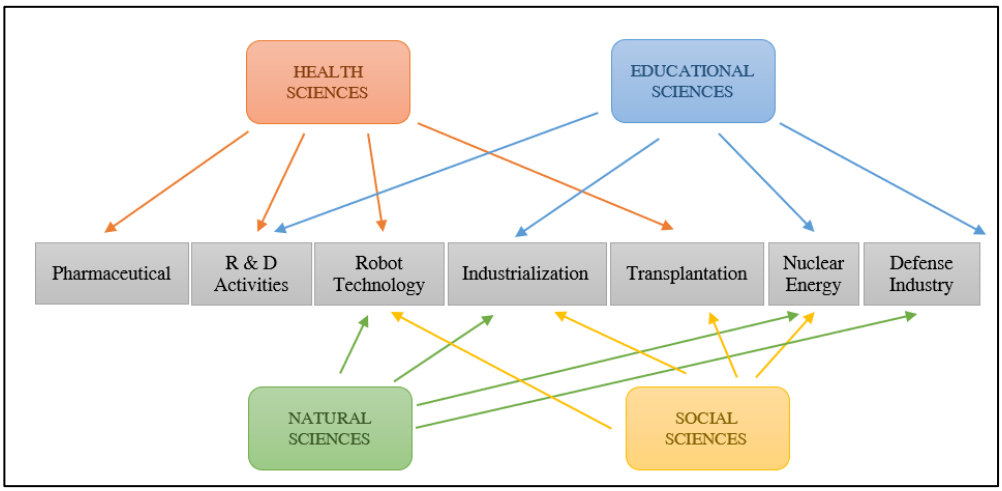
- Academics studying in the field of health sciences have stated that science has developed in the fields of biotechnology, robotics, nanotechnology, artificial intelligence, and space travel. A05 coded participant stated his/her opinion about this situation: "*Innovations in the biotechnological field such as the creation of artificial organs, in vitro fertilization, and genetic transformations, have been important in terms of health development*".

• Academics studying in the field of natural science expressed that 'in the field of quantum mechanics, nuclear energy, teleportation, biotechnology, and space travel, the science is developed. A19 coded participant described his/her opinion about this situation as: "*Because of the studies of Planck and Einstein, quantum mechanics studies that were encountered at the beginning of the 20th century have come to high-level formations today. The thinking that scenes we've seen in science fiction films for years will come true, creates new flashes in my horizons about the points where science will come*".

• Academics studying in the field of educational sciences have expressed that science has developed in the fields of quantum mechanics, nuclear energy, robotics, alternative energy, and artificial intelligence. A39 coded participant stated his/her opinion as: "*In line with the energy needs of societies, the search for new and effective energy resources has led to the orientation of structures such as nuclear energy and alternative energy sources*". Academics studying in the field of social sciences have stated that science has developed in the fields of teleportation, biotechnology, robotics, and nanotechnology. A33 coded participant expressed his/her opinion: "*Using Horizon 2020 or Industry 4.0 platforms we have information about robot technology, nanotechnology, and biotechnology concepts, I think that the work is carried out around the world.*"

The sixth theme of the research was asking the academics about "the development of science in Turkey" and "In which fields, science is developing in our country?". The data obtained from the participants are presented in Figure 7.

Figure 7. *The Views of Academics about the Development of Science in Turkey*



As Figure 7 illustrates, the views of academics on the development of science in Turkey are gathered under seven different headings: R&D Activities, transplantation, defense industry, robot technology, nuclear energy, pharmaceutical, and industrialization.

• The academics, studying health science, mentioned that science has been developed in the fields of R&D activities, transplantation, robot technology, and pharmaceutical. A47 coded participant stated his/her opinion as: "*I can say that the studies on science in Turkey are more tendencies to follow what is done around the world. For this reason, studies are more focused on research and development themes. I know we're in pretty good condition only about organ transplants. I am aware of the existence of those who come to our country only for this process in various countries. Recently, it has been widely seen that existence of studies for the use and creation of smart drugs*".

• Academics studying in the field of natural sciences have stated that science has developed in the field of the defense industry, robot technology, nuclear energy, and industrialization. A01 coded participant stated his/her opinion as: "*Although there is a lot of speculation about nuclear energy and even negative opinions by the public, the idea of having energy has led to our orientation towards nuclear energy. Within this orientation, factors such as mechanization and robotic applications, as well as manpower, need to be developed*".

• Academics studying in the field of educational sciences have stated that science has developed in the field of R&D activities, the defense industry, nuclear energy, and industrialization. A17 coded participant stated his/her opinion as: "*The studies, which are expressed as R & D, are generally based on the need for energy*

and industrialization. From the defense industry to the process of mechanization in agriculture, in many areas, such studies find their places".

- Academics studying in the field of social sciences have stated that science has developed in the field of organ transplants, robotics, nuclear energy, and industrialization. A64 coded participant stated his/her opinion as: "*When I came across this question, it came to my mind, the promises, especially in the newly opened educational institutions. I think that the students will be studying in such areas as the construction of the next fifty years, along with applications such as robotics and coding education. When I also think of this way of understanding all over the world, I consider it normal to have situations like nuclear energy, robot technology, and mechanization in industry, in our country*".

DISCUSSION AND CONCLUSION

Academics have been shown to frequently employ book definitions when describing the idea of science. Academics were anticipated to assemble under similar themes for the idea of science and incorporate book definitions, given the universality and semantic and conceptual infrastructure of science. This condition is supported by the participants' attitudes toward science, which include efforts to explain and investigate the cosmos as well as statements about helping the individual and society. When the literature was on the subject, graduate students recognized the concept of science (Kurtdede-Fidan & Konak, 2016). They describe the cosmos, social, cultural, and technical advancements, and concentrate them on the dimensions of benefitting mankind. In this regard, the study done by Kurtdede-Fidan and Konak (2016) was found to be parallel to the study. On the other hand, academics were perceived to bring some notions to the fore depending on the faculty variable they served. Academics working in the field of health sciences solve problems gather evidence, and practice medicine; academics working in the field of social sciences reason and experience; academics working in the field of a science experiment, observe, and find Academics in the field of educational sciences have been shown to have privatized the ideas of issue, process, and innovation. It is considered that research-study areas and the terminological use of ideas within these areas influence the creation of related concepts. Academics in the field of health sciences describe the process in the context of the disease, consider how to solve the disease based on this scenario, and gather proof by doing the necessary exams for the presence of the disease to support the relevant thinking. Similarly, academics working in the field of science place a premium on methods like experimentation and observation, which they frequently prefer during the research and experimentation process, which is based on variables specific to their research fields, revealing the impact of academics' book definitions and terminology in research-study areas in defining the concept of science. In this regard, DiGironimo (2011) underlines the need of providing science-society-environment interaction to define and make comprehensible the notion of science, as well as to explain the diversity in definitions of the concept of science by academics working in various domains. Furthermore, based on McComas (2002)'s definition of the idea of science, the focus on epistemological values and perceptions, i.e., the aspect of individuality, explains the similarities and variations in the concept of science concerning this research. The reason natural science academics came to this conclusion is that they are continually engaged in exploring this issue by pondering natural changes (Ruby & Decety 2004). According to Ari (2010)'s research, science prospective instructors define science as a product of living, inquiry, and questioning for the benefit of mankind, to sustain and progress their existence, as well as an attempt to comprehend oneself and the cosmos. It was observed that potential social science instructors were focused on comprehending and commenting on the science. Based on these findings, academics in this field have always been able to manage the instances that have come their way and continue their research in this manner. Most academics in the Department of Architecture have been seen to be focused on the observation of experiments and observations, depending on their beliefs on the concept of science. The reason architects have such a strong attitude toward science may be because their occupation requires them to constantly experiment with things. It was discovered that most academics in the engineering department focused on comprehension and interpretation when it came to the concept of science. The rationale for this conclusion is that artists may be constantly trying to propel their civilization ahead (Czarniawska, 1998; Gabriel, 2004) Scientists, social scientists, and academics in the engineering department may focus on understanding and interpreting code because they are attempting to make sense of nature, social scientists are attempting to make sense of society and structure, and academics in the engineering department are attempting to make sense of the products that occur within their departments. It's possible that the goods put through trial and error by the academics in the department of architecture in selecting the experimental observation code were beneficial. The reason why artists focus on the code of utility for mankind can be deduced from their departments: they are attempting to advance by placing society at the heart of their efforts. When academics' ideas on the

connotation of science are explored, it is found that scientists place a greater emphasis on inquiry and questioning in the connotation of science. The reason for this is that natural scientists strive to investigate every event in nature through the lens of their department. It was discovered that social scientists, like natural scientists, concentrated on studying and questioning in the context of science. The reason for this outcome might be attributed to the fact that social scientists are constantly studying society. Students highlighted the expression of utility in their impressions of science in research done by Uslu, Kocakulah, and Gur (2016). As can be observed, there is no resemblance between the work done and the research indicated above. The academics in the engineering department appear to be focused on science connotations, with the bulk focusing on innovation. This conclusion may be due to the academics in this department's ongoing efforts to create innovative technological items. While the professors in the department of architecture have a scientific bent, it was discovered that most of them are focused on innovation. The reason for this conclusion might be related to the nature of its departments, which are constantly attempting to come up with fresh ideas to stand apart. It was discovered that most academics in the art department identify science with experimentation and observation. This conclusion may be reached since they are always attempting to develop new items. Taking all of this into account, it can be stated that natural scientists study nature and the events that occur in nature, social scientists study changes in society and society, and researchers study research and inquiry procedures to learn about society and its changes. This may be because academic engineers and architects were focused on innovation to make a difference in their fields, continuously pushing to build new goods. Furthermore, it may be stated that academics who are artists were focused on the experiment and observation code, because of which they regard science to be merely experiment and observation. When academics' ideas on the origin of science were explored, it was discovered that they focused mostly on the concept of curiosity. The cause for this outcome might be attributed to natural scientists' efforts to learn about natural events and circumstances. Mar (2011) found that there is always science and the reality of knowing that evolved due to man's curiosity about himself and his cosmos in their study on the birth of science.

It has been observed that social scientists, like scientists, have stressed the idea of curiosity in understanding the birth of science. The reason for this might be that social scientists work hard to learn about new and complicated events in society and their causes. It has been observed that while discussing the birth of science, academics in the engineering department mostly concentrated on the notion of curiosity. Academics from engineering departments may be the source of such a conclusion since they are always studying and eager to produce new advancements to think about the future. Academics from the architectural department have been seen emphasizing curiosity, quest, and requirement while discussing the origin of science. When describing the origin of science, professors in the art department frequently highlight the notion of curiosity. Artists' interest to explore all that is going on around them, having a unique spirit, and preventing imitation may be the cause for such a judgment. Considering this, all academics focused on the code of inquiry, but academics in the department of architecture were also searching for and requiring codes. The reason for this may be seen in the fact that in the items they manufacture, they prioritize human needs and develop a variety of products to satisfy those requirements. When academics' views on the good and bad parts of the research generated are investigated, natural scientists have voiced views in both directions. The explanation for this conclusion might be caused; it is possible to say that natural scientists and the framework of their department are both parts of their output. It has been found that social scientists' perspectives on scientific creation may be both good and negative. The rationale for this conclusion is that it is possible that academics in this department, because of their interest in society, communicate their thoughts by thinking about how the products of research will have a greater impact on society. Academics in the engineering department have been observed emphasizing the code as having "both positive and bad aspects." This might be because scholars in this sector can consider both ways about the items they create. It has been observed that academics in the department of architecture and other fields have underlined the code as having "both good and bad aspects." This might be due to their professional attention to the consequences of science products, particularly on humans, due to the foregrounding of human needs. Although there is no majority, academics in the art department have focused on the codes "what makes science bad is the objective of man" and "negative elements of science as well as good aspects are available." The cause for this conclusion might be attributed to academics from this field who have focused on the human component more than anything else. Science's outcomes are bad, as "it has led mankind to a place where it cannot fathom." "It has seized many of humanity's principles and turned them into chaos," says the author. As can be observed in this study, the negative aspects of science are stressed. However, both good and bad elements of science were acknowledged in our study. Based on these findings, it's clear that several academics, including natural scientists, social scientists, engineers, architects, and artists, focused on the code "both bad and good parts of science are available." It has been observed that several artist academics have focused on the code "what makes science bad is man's objective." When the examples offered by academics were investigated to

determine if they were connected to the good or bad parts of science, it was discovered that natural scientists focused on activities in medicine, positive aspects of atom breakdown, and nuclear energy codes. As an example, they seem to have focused on the coding of the bad actions of the atomic bomb. They may have come to this conclusion because they're acting within the confines of their departments. According to Balki, Coban, and Aktas (2003), most students decided that they concentrated on the treatment of disorders associated with science's positive aspects. This outcome is consistent with natural science professors' responses. It can be observed that they focused on medical and technology codes as an example of social scientists, as well as the science's good aspects. They appeared to be focused on the negative aspects of the atomic bomb (Hiroshima and Nagasaki) code. The academics in this department may have reached this conclusion because they place society at the core of their research and, as a result, deal with issues that influence society. It has been observed that engineering academics focused on instances such as the "medicine" code as a good side and the "negative activity of the atomic bomb" code as a bad side. This might be because academics analyze the consequences of the goods, they make in their profession on society by thinking both ways. Academics from the architecture department were found to be focused on the positive side of the code "medicine," the negative side of the code "negative activity of the atomic bomb," and the negative side of the code "weapons used in war and negative activities of technical instruments." It is possible that this conclusion was reached because academics were more interested in contemporary concerns, causing society to be impacted. Academics from the art department have been observed focusing on the positive side of the code "manufacturing of medical devices." They appeared to be focused on the negative aspects of the atomic bomb (Hiroshima and Nagasaki) code. The reason for this conclusion may be that the artist was particularly interested in issues that were important to society.

The scientist, according to teacher candidates, is someone who examines events and facts in the universe, investigates the source of the mystery underlying it, tries to understand the causes of this mystery, simplifies what he understands, and publishes it in a way that the public can understand (Lin-Siegler et all., 2016). According to the findings of the study, academics from natural science departments are mostly focused on the research-inquiry codes. The reason for this conclusion may be that natural scientists, like scientists, utilize inquiry to grasp what is going on around them and the facts of nature and to arrive at concepts and hypotheses that help them explain what they see. As a result, it can be shown that the above-mentioned teacher candidates and natural scientists had similar definitions. Ari (2010) employed close expressions about the scientist when interviewing prospective science teachers and classroom teaching applicants. Consequently, scientists possess characteristics such as researcher, objective and creative mentality, critical thinking, and persons who ask questions. Prospective science teachers and classroom teacher candidates provided comparable responses to natural scientists' academics. It has been observed that social scientists have placed a strong emphasis on the "research and inquiry" code. This conclusion may be reached because social scientists study society and the events that occur within it, as well as the causes and repercussions of these occurrences. Because of Senel and Aslan's (2014) study, teacher candidates have described scientists as persons who have done important work for mankind, which is distinct from what we've done. Academics from the engineering department were observed concentrating on "expert" code. The explanation for this finding might be that when the academics in this department's working conditions are inspected, they aim to major in their departments by continually exposing various things. Academics from the architecture department were observed concentrating on the "research and inquiries" code. The explanation for this conclusion might be that architects, such as engineers, are always conducting a study to unveil new items or make a difference. Academics from the art department, like those from other disciplines, focused on "research and querying" code. The reason for this conclusion might be that an artist who wants to reclaim his identity must be prepared to work for many years, be free of the influences of other artists, and conduct an ongoing study to develop a unique aesthetic. Based on this, it can be inferred that natural scientists, social scientists, architects, and artists focused on the "research-questioning" code in their opinions regarding the definition of "science" since they are researching when dealing with any issue inside their respective departments.

When academics' opinions on the term' scientist' were explored, it was discovered that natural scientists focused on the 'Aziz Sancar' code. The rationale for this conclusion might be because the individual described has won a Nobel Prize. It has been observed that social scientists have focused mostly on the 'Aziz Sancar' code. This might be because social scientists see daily happenings since they are part of society. Academics from the engineering department were found to be mostly focused on the 'Nikola Tesla code. This might be because the engineers believe Nikola Tesla is closer to them because of his technological creations. It was discovered that academics from the architecture department focused mostly on the 'Aziz Sancar' code. The explanation for this conclusion might be that architects keep up with current events, and Aziz Sancar's work is at the forefront right

now. Academics from the art department were also largely focused on the 'Aziz Sancar' code. The reason for this conclusion might be because, as previously said, Aziz Sancar's work is at the forefront. Based on all of this, it's clear that most academics focused on the 'Aziz Sancar' code. This conclusion might be because Aziz Sancar is at the vanguard of his work, has won the Nobel Prize, and academics monitor everyday occurrences in such a way.

When academics' thoughts on the growth of science throughout the world are analyzed, natural scientists focused on the 'space science' code. When looking through the literature, some studies come to similar conclusions (Fivush & Nelson 2004; Klein 2015; Schacter, Addis, & Buckner, 2007). This might be because natural scientists deal with astronomy in their profession, and space research is at the forefront. It was discovered that social scientists focused on the 'space science' code as well. This might be because social scientists keep track of daily happenings. As a result, science in the subject of space exploration is progressing globally. Because of space research, advancements in other domains such as medicine, physics, chemistry, biology, and industry may be seen. Academics in the engineering department have been noted to voice their views mostly about medicine. Academics have played an essential part in the creation of novel procedures and instruments to be employed in the diagnosis and treatment of illnesses for many years, because of their respective disciplines. It has been seen those academics from the architecture department, namely engineers, have focused on the 'medicine' code. The explanation for this might be that architects are required by their departments to keep a careful eye on everyday events around the globe (Zeliadt, 2013). Academics from the art department have traditionally focused on the 'defense industrial' code. The reason for this conclusion might be that many nations are at war now because of their geopolitical location, and society is impacted by works created by artists who are inspired by the geography and the characteristics of the age in which they live. Based on these findings, it's clear that academics from natural sciences focused on the 'space science' code that is relevant to their field. It might be argued that social scientists chose this coding because they are interested in current events. When we look at the departments of architecture and engineering, we can see that both departments are focused on the 'medicine' code for this reason; engineer academics choose this code because of the products that they produce related to their department, and architecture academics choose this code because they follow daily events, to put it another way. Finally, art department academics focused on the 'defense industrial' code. The rationale for this judgment is that they are attempting to influence society through the works they have exposed, and the way society monitors regular occurrences.

When academics' views on the growth of science in certain areas in Turkey are analyzed, natural scientists are mostly focused on the 'industrialization' and 'defense industry' codes. The explanation for this conclusion might be that Turkey can make mandatory changes owing to its geopolitical location, and academics in this department keep up with everyday happenings. It's possible that social scientists focused on the 'natural scientist' code because they compete with the natural science department and express it at every chance, and they believe that in Turkey, their discipline is not given enough attention. Academics from the engineering department were found to be mostly focused on the 'defense industry' code. This situation: perhaps because they are very interested in technology items that are relevant to their sector and are now a hot topic. As can be seen from the following: Turkey expanded investment in the military sector, and academics have been proven to respond as a 'defense industry', considering the circumstances. Academics in the architectural department have been observed concentrating on the 'medicine' code. This situation may exist since our country is well-known in medicine and serves as an example to other countries. It might also be because the professors in this area keep a careful eye on advancements, particularly in medicine. Academics from the art department were likewise largely focused on the 'defense industrial' code. This might be because, as previously said, artists closely watch the turmoil of society to create works that impact society. Those R & D activities in advanced application areas, such as biotechnology, gene engineering, software, information and communication technologies, new materials, space science and technologies, nuclear technology, utilization technologies from seas and submarines, great science, and clean energy technologies, were expressed in the study conducted by Ciftci (2004). According to the findings of this study, knowledge advances not only in the fields of medicine and defense. According to the above-mentioned survey, science is progressing in several fields in Turkey. As a result, it differs greatly from our research. When a conclusion is drawn based on all of this, the fact that scientists, engineers, and artists are focused on the "military sector" may be impacted by the turmoil in our nation owing to its geopolitical location. However, when comparing departments, this may be because professors in the science and engineering department are interested in items utilized under the code of “defense industry”. Social scientists may be focusing on the 'natural science' code because they believe they are less significant in Turkey and that there is more research on natural science.

Implications

- When the obtained data are examined, it is seen that academics frequently use the definitions in scientific books when defining the concept of science. Additionally, it is seen that the academics present common ideas about explaining the universe and providing benefits to society. On the other hand, it is seen that the department variable in which academics work is effective in revealing information that is not common in defining the concept of science. In this sense, the following implications are offered to academics and researchers; (i) The opportunity should be provided for academics to make sense of terminological concepts non-area and to gain an interdisciplinary perspective. (ii) The effect of the department in which academics work on the process of defining the concept of science can be examined in depth and research can be carried out on the variables that may have an impact.

- When the opinions of academics towards the concept of scientists are examined, it is seen that the department in which academics work, actuality, and popularity factors have an effect. The fact that popularity and actuality influence the concept of a scientist is an indication that the elements of the nature of science are internalized by academics. The fact that the department variable in which academics work affects the concept of the scientist is due to the similarity between the scientist's and the academic's field of study and scientists have made scientific contributions in the relevant field. In this sense, academics can be taught awareness about scientists who carry out studies in different fields and their contributions to science.

- When the opinions of academics on the possible scientific developments in the world and Turkey are examined, it is seen that a common idea about robot technology has been formed. Concordantly, it is necessary to raise awareness among scientists, academics, researchers, and society about the nature, development, and use of robot technology. On the other hand, while the necessity of space-related studies in the world for the development of science is emphasized, the necessity of studies on industry and defense in Turkey is emphasized. It is thought that the criteria needed by societies and geopolitical positions have an impact on the emergence of this situation. In this sense, the following implications are offered to researchers; Research can be carried out by comparing the opinions of academics working in different countries about scientific development. Thus, the role of the social need factor and the importance of geopolitical position in the process can be revealed more deeply.

Statements of Publication Ethics

Ethical principles were followed in this study. The necessary ethical approval was obtained from Trabzon University Social and Human Sciences Scientific Research and Publication Ethics Committee dated 13/02/2023 with the decision number E-81614018-000-2300011184.

Researchers' Contribution Rate

The first author is responsible for organizing the research process, establishing the conceptual framework, and collecting the data. The second author is responsible for organizing the research process, collecting the data, and transcribing the data. The third author is responsible for organizing the research process, analyzing the data, and creating and interpreting the findings.

Conflict of Interest

There is no conflict of interest for this study.

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