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Science Teacher Candidates' Views about Science-Technology-Society-Environment Relations*

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ABSTRACT

Purpose: Awareness of the interaction between science, technology, society, and environment (STSE) is seen as important in life in the modern world. Therefore, the present study aimed to examine the science teacher candidates' views on relations between science, technology, society, and environment.

Research Methods: In this research, which used the phenomenographic study method, the data were obtained through drawings and interviews. The participants in this research consisted of 145 volunteer students who were studying in science teaching at a state university in Turkey during the 2018-2019 academic years. Content analysis and descriptive analysis methods were used to analyze the obtained data.

Findings: Research findings revealed that science teacher candidates' understanding regarding STSE was the superficial correlation of these four concepts with each other. The majority of science teacher candidates had partial information and image of STSE. Science teacher candidates predominantly made drawings and expressed opinions regarding the negative effects of technology on society and environment and negative effects of humans on the environment. In addition, it was observed that the concepts of socioscientific issues, the nature of science and sustainable development were emerged implicitly in the drawings and views of some of the science teacher candidates regarding the STSE.

Implications for Research and Practice: In the light of these results, it can be suggested to organize learning environments where the STSE relationship can be learned more deeply by science teacher candidates. It can be recommended to develop sustainable development awareness within the scope of STSE.

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Introduction

Cultural, economic and political changes constantly affect life in scientifically and technologically developing societies (Chowdhury, 2016). Modern human constantly faces the positive or negative effects of science and technology in their daily life. Therefore, countries leading the advancement of science and technology attach importance to science and technology education. At the same time, these countries are trying to improve the quality of science and technology education (Çepni, Bacanak, & Küçük, 2003). Science and technology are closely interrelated. The innovations in technology affect the developments in science and the developments in science affect the innovations in technology. The technology that exists in all areas of today's life leads to novel scientific developments and innovations in many areas. Thus, individuals should see science and technology as two complementary parts, understand the connection between them, and carry this relationship to their daily lives (Toraman, 2013).

Science and technology have close relationships with society as well as relationships with each other. Therefore, the concepts of Science-Technology-Society take place together in many sources. The Science-Technology-Society (STS) approach is an interdisciplinary approach. On the one hand, this approach explores and understands how modern science and technology may shape modern culture, values, and institutions; on the other hand, it explores how modern values shape science and technology (Mansour, 2009). This has led to controversial issues involving science, technology, and society. Awareness of socioscientific issues started to increase with the STS approach (Chowdhury, 2016; Hughes, 2000). STS is a movement that contributes to the development of scientific literacy and technological literacy (Akcay & Yager, 2010). One of the most important dimensions of scientific literacy is to understand the nature of science. STS is also an approach that affects understanding the nature of science and technology (Yalvac, Tekkaya, Cakiroglu, & Kahyaoglu, 2007). STS teaching helps students understand the philosophy, sociology, and history of science (Yager, 2007).

By including the environment in the STS approach, this approach was transformed into the Science-Technology-Society-Environment. Today, however, the STS and STSE approach continue to be used interchangeably. Some countries have adopted this approach in the form of STS, and some countries as STSE. In Turkey, where the data of this research were collected, the STSE approach was adopted. In the science curriculum of Turkey, the sub-dimensions regarding STSE were socioscientific issues, the nature of science, sustainable development, the relationship between science and technology, the contribution of science to society, science and career awareness (MoNE, 2013).

Literature Review

In their work, Calado, Scharfenberg, and Bogner (2018) compared the handling of the STSE approach in German and Portuguese biology textbooks. They found that the

most basic difference in the handling of STSE in the textbooks of the two countries is the topics chosen. Although they found many common points regarding STSE in textbooks, they found differences in the handling of STSE in textbooks due to the socio-cultural effect.

Yener, Aksüt, Kiras, and Yener (2018) asked science teacher candidates what the STSE meant before and after organizing a science museum trip. Before the trip, 50% of the students answered STSE interaction (Science, Technology, Society and Environment interaction); and after the trip, 53% of the students answered STSE interaction. For almost half of the science teacher candidates, STSE was all about the interaction of these four concepts with each other.

Yalaki (2016) prepared a course in which teacher candidates were trained with the STSE approach. At the end of the course covered by the STSE approach, the researcher revealed that the teacher candidates' perspectives on the nature of science changed. Yalaki (2014) investigated the status of STSE education in science education. In his research, he stated that the necessary attention was paid to the STSE approach in the 2005 and 2013 science teaching curriculum of Turkey. However, although the STSE approach was expressed as a sub-learning area and objective in the curriculum, he stated that there were deficiencies in the implementation of these objectives.

Calado, Scharfenberg, and Bogner (2015) studied biology textbooks from two different publishers in Germany. Their findings showed that both of the books dealt with the science and technology relationship. They claimed that one of the books highlighted the social impacts, while the other emphasized the environmental impacts. The way the books handled the sociological topics defined as controversial issues were also different. They found that both of the books contributed to the understanding of the STSE approach despite the lack of relevant information although they were prepared according to the same directive, the way they dealt with the STSE approach varied significantly.

Toraman (2013) concluded that students' STSE associations were strengthened with the activities performed by paying attention to STSE objectives. In her study, Demirçalı (2014) observed that the development of students increased in the science lessons with the STSE approach. When Çınar (2013) investigated the teacher candidates' views about STSE, he found that the teacher candidates thought there was a strong relationship between science and technology, but they thought that technology was science-dependent. The findings showed that the effects of science, technology, society, and environment against each other were considered insufficient.

Dikmentepe (2012) investigated the teacher candidates' views about STSE according to their grade levels and observed that the confusion in students decreased as the grade level increased. In addition, students argued that science, technology, society, and environment were effective on each other. Atasoy (2012) investigated the impacts of environmental objectives on students from the STSE sub-learning area included in the curriculum, and he observed that the STSE learning area did not have an impact on students' attitudes towards the environment and increased the level of knowledge about the environment. Çınar (2011) found that primary school teachers

did not have sufficient knowledge about the relationships between science, technology, society, and environment, and had misconceptions about the nature of science and technology. Aikenhead (2009) stated that science, technology, and society approach in science lessons improved students' attitudes towards science in a positive way.

When the studies in the literature are reviewed, STSE appears in three different ways. The first of these is document review studies examining the way STSE is handled in textbooks or curricula. The results of these studies show that the way STSE is handled in textbooks differs according to countries; that the textbooks prepared according to the same directive also differ in the way they handle STSE in the same country; and even though STSE is given enough importance in the curriculum, this understanding does not have the same level of importance in its implementation. The second is experimental studies in which STSE is handled as a teaching approach. Experimental studies show that STSE has a positive effect on students' affective and cognitive development. The third is qualitative and quantitative descriptive studies in which views and perceptions about STSE are revealed. When the studies in the third category were examined, it was revealed that the four concepts that constitute STSE, namely science, technology, society and environment, were perceived as a simple association with each other and that teachers and teacher candidates did not have sufficient knowledge about STSE.

The importance of the study and the research problem

In light of the studies in the literature, it is seen that science teachers should have an awareness in order for the STSE approach to be understood by the students. The results of the studies conducted in Turkey suggest that students and teacher candidates could not fully grasp the STSE approach takes although it takes part in the curriculum. To fully teach the STSE approach, it is important to be aware of the relationships between the concepts of science-technology-society-environment, as well as the awareness of new dimensions, such as socioscientific issues, sustainable development, and the nature of science. Unlike the studies in the literature, STSE was not considered as a teaching approach in this study. Instead, how science teacher candidates perceive the relationships between science-technology-society-environment concepts in the STSE approach was investigated. Besides the relationships between the concepts that make up the STSE approach, the different situations that will arise as a result of the integration of these concepts increase the importance of this study. It is important to reveal whether STSE has been learned correctly and in-depth by science teacher candidates to provide students with the objectives of this field in the future. The present study aimed to investigate how science teacher candidates perceive STSE relations. For this purpose, the following questions were sought.

1- How do science teacher candidates perceive the relationship between Science-Technology-Society-Environment?

2- How do science teacher candidates perceive the STSE approach?

Method

Research Design

This research, which used a phenomenographic study design that is one of the qualitative research types, aimed to understand the science teacher candidates' opinions about science, technology, society, and environment (STSE) relations. Phenomenographic study tries to establish a relationship between the individual and the subject of learning, seeks answers to some questions regarding learning and thinking (Marton, 1986). The phenomenographic analysis was developed in the early 1980s and became extremely popular in the education field. Erten, Kiray and Sen-Gumus (2013) used this analysis method in the analysis of the Draw a Scientist Test. From the student drawings in the DAST, the authors created categories and presented the frequencies of these categories in the form of a table. Similar to Erten et al.'s (2013) study, science teacher candidates were asked to draw what they understood from the STSE on a blank white paper as in the DAST. After the drawings, categories were created and the frequencies of these categories were given.

Participants

Convenience sampling method was preferred in this study. The participants in this research consisted of 145 science teacher candidates who were studying in the third and fourth years at a state university in Turkey during the 2018-2019 academic years. Participation in this study was voluntary. The participants were 129 females and 16 males.

Data Collection Tools and Reliability-Validity

STSE test and interview were used as data collection tools in this study that was conducted to reveal the views of science teacher candidates on the relationships between science, technology, society, and environment. In this study, the STSE test was given first and face-to-face interviews were conducted to strengthen and triangulate the findings obtained from this test.

STSE test

The STSE test was inspired by the Draw a Scientist Test (DAST) instrument. To test whether the DAST can be used for STSE or not, a pilot study was conducted with five science teacher candidates before the application. The opinions of two experts in science education were asked about these drawings and it was decided to use the DAST instrument as STSE test. The STSE test consists of blank sheets of A4 paper with the instruction "draw the relationships between science, technology, society, and environment". The drawings made by teacher candidates on these papers were brought together according to their common characteristics and coded by giving a name for each category. The drawings were examined and evaluated by three field experts. Concerning the reliability of the drawings, the drawings were coded by another researcher in the field of science education and the categories were re-created. The consistency between these two coding was calculated by comparing the categories of researchers with the agreement percentage formula of Miles and Huberman (1994).

Reliability Percentage = (Agreement)/(Total Agreement + Disagreement)

As a result of the calculations, the agreement percentage between categories was calculated as 0.89 and this study was accepted as reliable because the percentage of agreement was above 70%. The frequency and percentages of the categories created from the drawings were calculated and presented in Table1.

Interview

Semi-structured interview questions were created by the researcher. The interview questions were examined by two faculty members who were experts in science education, and the questions were finalized. A pilot study was conducted with a teacher candidate using the finalized questions. The interview was recorded with a voice recorder, and then verbatim transcription was made to a word document by the researcher. The pilot study was evaluated by two field experts, and some minor revisions were made to the questions. The main questions used in the interview are given below.

1- What did you want to tell in your drawing? Can you explain it?

2- Why did you draw such a drawing? Can you explain it?

3- Do you think there is a relationship between the concepts of Science-Technology-Society-Environment? Can you explain it?

4- What is the STSE approach for you? What is included in the STSE? Can you explain it?

After the pilot interview, the final interviews that constituted the data in this research were conducted. One-on-one interviews were conducted with each individual in a silent environment. The duration of the interviews lasted, on average of 35 minutes. Each interview was recorded as in the pilot study. The interviews that were audio-recorded were transcribed verbatim. The interview data obtained were combined with the drawings and reported. While these two data were combined, the teacher candidates' drawings were taken to the center and the explanations made by the teacher candidates over these drawings were given as direct quotes after the drawings.

Data Analysis

Content analysis and descriptive analysis were used to analyze the data obtained in this study. Content analysis was performed according to pre-determined codes and codes determined by concepts derived from the data (Strauss & Corbin, 1990). Once the themes or codes are determined, a frequency table can be created that shows how often these codes and themes take place. After creating the thematic framework in the descriptive analysis phase, direct quotations can be included (Yıldırım & Şimşek, 2011). In this study, to reveal the pattern from the drawings made by students, salient codes were created by paying attention to the concepts of science, technology, society, environment, and the relationships between these concepts. Similar drawings containing a common characteristic belonging to a category were brought together.

The frequency and percentages of the combined drawings were calculated and presented in Table 1. The data collected from the interviews were audio-recorded by the researcher, and later, they were transcribed verbatim. The data obtained from the interviews that supported the drawings were given as direct quotes.

Results

The findings of the study were obtained from STSE drawings and interviews. The categories, frequencies, and percentages created from science, technology, society and environment relationship drawn by science teacher candidates are shown in Table 1.

Table 1.

STSE Categories, Frequencies, and Percentages of Students' Drawings

No	Category	Frequency (F)	Percentage (%)
1	Science-Technology-Society-Environment	64	44.14
2	Technology-Society-Environment	22	15.17
3	Technology-Environment	12	8.27
4	Society-Environment	11	7.58
5	Science-Society-Environment	8	5.52
6	Technology-Society	8	5.52
7	Science-Environment	6	4.14
8	Science-Technology-Society	4	2.76
9	Other	10	6.90
	Total	145	100.00

When Table 1 was examined, it is seen that approximately half of the science teacher candidates (44.14%) drew the relationship between science-technology-society-environment. The students tried to show the STSE relationship in three different ways in their drawings. The highest number of drawings after this category was in the technology-society-environment category with 15.17%. The technology-environment category ranked third with 8.27%. The society-environment category that followed this category was 7.58%. The science-society-environment category and technology-society category had the same percentage as 5.52%. The science-environment category was 4.14%, and the science-technology-society category was 2.76%. The other category constituted 6.90%. The categories created from the drawings of the students are given below.

Science-Technology-Society-Environment (STSE) Category

When the science teacher candidates' drawings were examined, it was seen that most drawings were about the science, technology, society, and environment category. In this category, the students tried to show the relationship between these concepts by including all four concepts of science, technology, society, and environment into their drawings. Students mostly dealt with nature and living creatures in their drawings to represent the environment and included technological tools that can be used in scientific research and technological tools used in daily life. The drawings in this

category came to the forefront with people conducting scientific research or images containing scientific research. Some drawings contained positive messages, while others contained negative messages about the STSE relationship. Drawings of students 17 and 145 regarding STSE are given in Figure 1.

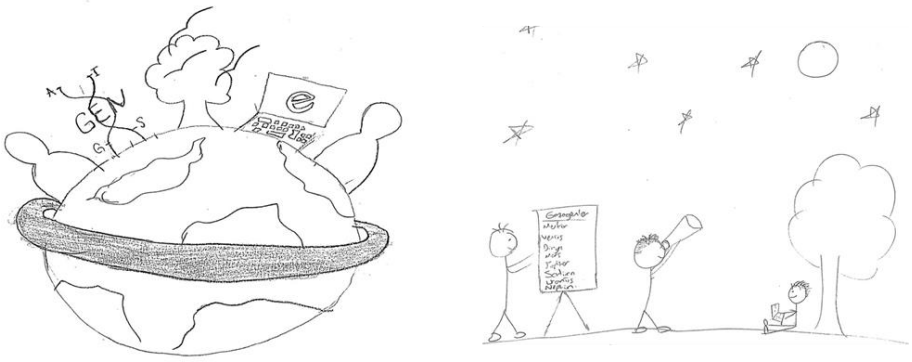

Figure 1. *Drawings of Student 17 (left) and Student 145 (right).*

It was seen in the drawings and interviews that the students emphasized the positive and negative aspects of the STSE relationship. Socioscientific issues came to the forefront in students' drawings and views on STSE. The student 17's view about STSE is given below.

S17: *"For example, in our daily life, especially the power plants will improve in the field of science, but at the same time, the damages to society and the environment are also taken into consideration. It is something like an example for science and social field, but there is also a discussion about whether these plants should be built or not."*

Technology-Society-Environment Category

When the drawings of science teacher candidates were examined, it was seen that the technology-society-environment category took second place. In this category, students tried to show the relationship between these three concepts by drawing the concepts of technology, society and environment together. Students mostly showed in their drawings that technology and society harmed the natural environment and living things. Drawing of student 125 can be given as an example of this negative perception in Figure 2. In addition, there were drawings that pointed to the positive effects of technology on society and the environment, albeit in small numbers. Student 93's drawing regarding renewable energy sources, clean sky, and environmental drawing can be shown in Figure 2.

Student 125's view supported this negative point of view.

S125: *"Garbage [...] I saw in the news again last year, the factory dumped their waste to the river, and fish died. Then they closed it; however, the living things were harmed. Chemicals were already mixed to the water and cannot be cleaned, and fish cannot live now because we are not aware."*

Student 93's view can be given as an example of a positive perspective.

S93:" *[…] We can benefit from our own resources, renewable energy sources […] Materials that can increase the use of renewable energy sources can be produced. For example, the wind turbine is being made for wind energy; we can do this in a local way and offer it to foreign trade."*

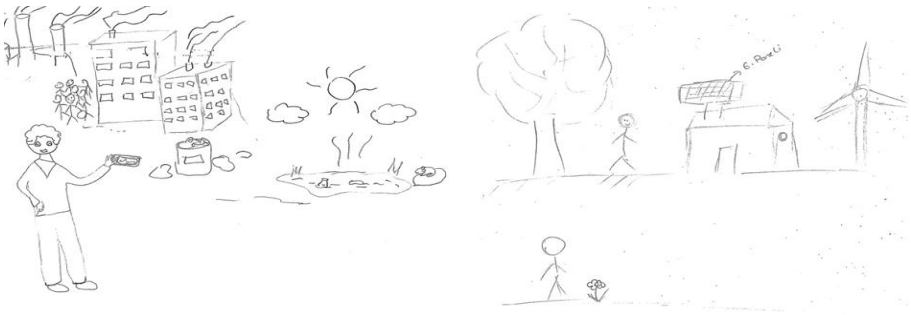

Figure 2. *Drawings of Student 125 (left) and Student 93 (right).*

Technology-Environment Category

Another category created from science teacher candidates' drawings was the technology-environment category. In this category, the students tried to show the relationship between these two concepts by drawing the concepts of technology and environment together. Students mostly focused on the negative effects of technology on the environment. The drawing of student 72 reflected this negative thought in Figure 3. The student 72's view also supported this drawing.

S72: *" […]maybe exhaust gases coming out of cars. Eventually, it pollutes the air and may cause environmental pollution."*

Figure 3. *Drawings of Student 72 (left) and Student 69 (right).*

In addition, there were students who included the technologies used to protect the environment in their drawings. An example of this situation was student 69's drawing regarding the relationship between technology and the environment in Figure 3.

Student 69's view was in line with the drawings made by student 69 and supported this finding.

S69: *"[…] Renewable energy sources can be used. For example, they are building solar power plants; this is a great measure to really eliminate the environmental problem with this energy […]"*

Society-Environment Category

Another category created from the drawings of science teacher candidates was the society-environment category. In this category, the students tried to show the relationship between these two concepts by drawing the concepts of society and environment together. In all of the drawings in this category, students showed that society harmed the environment. The drawings of student 100 and student 5 related to society and environment are given in Figure 4 as examples.

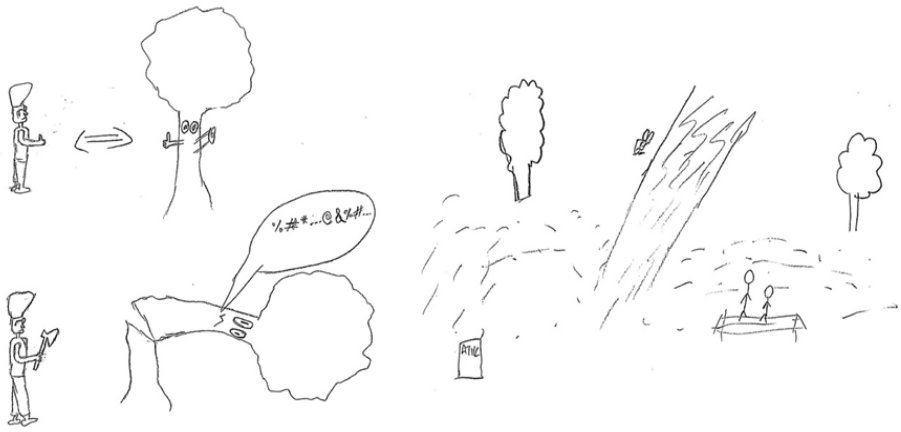

Figure 4. *Drawings of Student 100 (left) and Student 5 (right).*

Student 100 and Student 5's views also supported this finding.

S100: *"[…] For example, we reduce the afforestation extremely, landslides may occur in the places we reduce the afforestation. Actually, we create a problem, and the things that happen as a result happens because of us."*

S5: *"I think we should use our natural resources without consuming the environment first and without disturbing the balance of nature. In this way, we can sustain economic development. For example, we use something, and it ends after a while. This, of course, also disrupts the balance of nature. Thus, I think we shouldn't exploit nature or all the resources we use. We need to use it consciously […]"*

Science-Society-Environment Category

Another category created from the drawings of science teacher candidates was science-society-environment category. In this category, the students tried to show the relationship between these three concepts by drawing the concepts of science, society, and environment together. In the student drawings, mostly people who made research

in nature came to the forefront. The drawings of student 71 and student 65 are given in Figure 5 as examples.

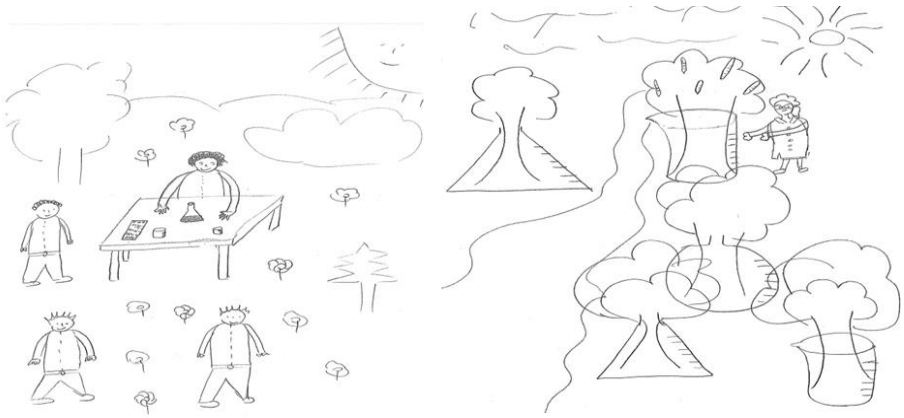

Figure 5. *Drawings of Student 71(left) and Student 65 (right).*

The student 71 and student 65's views also supported this finding.

S71: *"There is such a thing in the scientific study, what the object is or what the subject is studied depends on these people. There may be a laboratory environment, but for example, a geologist will not have a laboratory environment […]. Then we look at a historian. For example, he can look at archeology excavations and make scientific inferences from past wars. The working area of a doctor is the hospital, the human body[…] Everyone's scientific work is different; it happens in different places […]"*

S65: *"It depends on the scientific work we will do. If this scientific study is in nature, it will be through observation. In a laboratory environment, it happens by experimenting. It depends on what we will use."*

Technology-Society Category

Another category created from the drawings of science teacher candidates was the technology-society category. In this category, the students tried to show the relationship between these two concepts by drawing the concepts of technology and society together. Students mostly showed that technology negatively affected social life in their drawings. The drawing of student 92 related to technology-society is given in Figure 6 as an example. However, there were a few students who drew the contribution of technology to society. An example of this is the drawing of student 19 in Figure 6, which deals with students who study on the smart board.

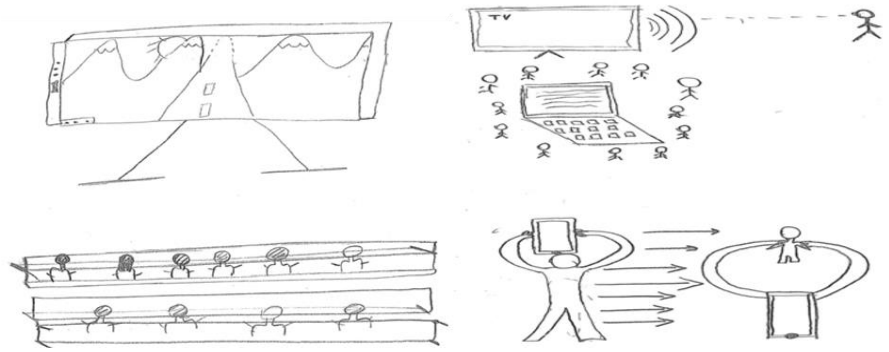

Figure 6. *Drawings of Student 92 (left) and Student 19 (right).*

The views of student 19 and student 92 also supported these findings.

S19: *"[…] Technology reflects on many things we use in daily life. The simplest example is that these boards are used in schools now; thus, this requires preparation. It has been developing until now. Is there any negativity? Probably yes!"*

S92: *"[…] Now computers, mobile phones, children have been growing up with tablets since they were very young, they are moving away from each other, they have no social environment, they are not intimately social with a social environment and become introverted and asocial. In general, hate is growing among people. The individuals hate each other as they get lonely."*

Science-Environment Category

Another category created from the drawings of science teacher candidates was the science-environment category. In this category, the students tried to show the relationship between these two concepts by drawing the concepts of science and environment together. According to the majority of students, a special environment was not necessary for science research, science studies could also be conducted in nature. The drawing of student 102 related to science and environment is given in Figure 7 as an example.

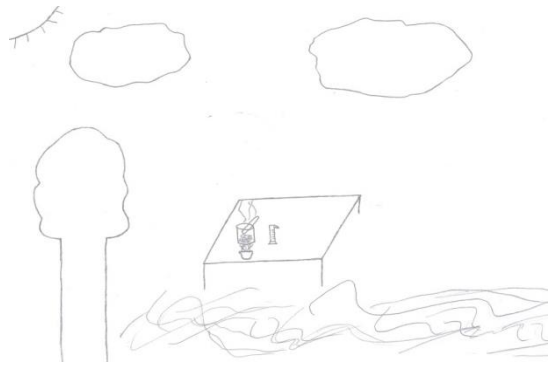

Figure 7. *Drawing of Student 102.*

The views of student 102 also supported this finding.

S102: *"Scientific study can be in a laboratory environment; it can be in nature. Naturalists, for example, can study animals and plants. Science can be conducted in any environment."*

Science-Technology-Society Category

Another category created from the drawings of science teacher candidates was the science-technology-society category. In this category, the students tried to show the relationship between these three concepts by drawing the concepts of science, technology and society together. Students mostly showed positive effects of science and technology on social life in their drawings. The drawing of student 60 about science-technology-society is given in Figure 8 as an example.

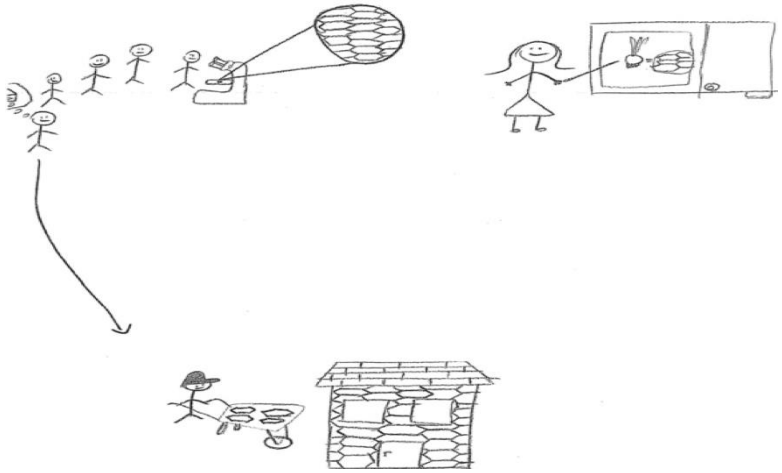

Figure 8. *Drawing of Student 60.*

The views of student 60 supported this finding.

S60: *"Even when we think of the smallest computer, if there was no electricity, for example, computer would not exist. For example, if we did not know the conductivity event, we could not do anything about electricity. These are the contributions of science and technology to us. If the atom was not known, a technological device such as an atomic bomb, a combat device could not be produced. For example, we saw the tiny structure of the onion skin with the help of technology. This is said in science, it is explained, but we do not see it with our eyes. Technology helps science. We can see them clearly and it is easier to learn."*

The Other Category

The drawings that fell outside of the above drawings were exactly those that could not be included in the scope of these categories. In the context of the relationship between Science-Technology-Society-Environment, 10 drawings that did not fully exhibit the characteristics of any category were collected under the category of "other".

Discussion, Conclusion and Recommendations

This study aimed to reveal the science teacher candidates' opinions on science, technology, society and environment. In this study, the findings showed that the students mostly focused on the science-technology-society-environment category in the relationships between the concepts of science, technology, society and environment. When the findings were examined, it was understood that students could establish STSE relationships in general, and there was a certain image about STSE relationships, in the students' mind. This might be the result that STSE was expressed in the existing curriculum since 2005 in Turkey. It was seen that controversial scientific issues came to the forefront in science teacher candidates' drawings and views about STSE. Teacher candidates' involvement in controversial issues on both positive and negative aspects of STSE may stem from their awareness of socioscientific issues. Socioscientific issues consider the scientific and technological phenomena as well as their impacts on society and the environment (Sadler, 2004; Yerdelen, Cansiz, Cansiz, & Akcay, 2018). Ozturk and Bozkurt Altan (2019), in their study that investigated the views of science teachers on the establishment of a nuclear power plant in Sinop of Turkey, observed positive and negative views about the impacts of a nuclear power plant, which is a socioscientific issue, on the science, society, technology, and environment. This finding was consistent with the findings obtained in this study related to STSE. Some researchers have stated that socioscientific issues include the Science-Technology-Society relationship (Zeidler, Walker, Ackett, & Simmons, 2002; Kabatas Memis & Ezberci Cevik, 2017). While science teacher candidates' drawings regarding STSE that included all four of these fields took the first place, some of the drawings that included science-technology-society also emerged; it may be because socioscientific issues were related to science, technology, and society.

In the drawings of science teacher candidates, the negative effects of technology on society and environment, human on the environment, and science and technology on society came to the fore. In some of the teacher candidates' drawings, two or three of these four concepts, which constitute the STSE, interacted with each other. The negative drawings of teacher candidates showed that the STSE relationship in their minds did not reflect the sustainable development approach. Sustainable development is based on maintaining a balanced and harmonious relationship between the economy, society and the environment (Tekbiyik & Celik, 2019). The concept of sustainable development emerged to find a solution to the negative effects of society on the environment and emphasized the revision of the relationship between society, environment, and economy to leave a livable world to the next generations (Atmaca, Kiray, & Pehlivan, 2019). Sustainable development, as socioscientific issues, is also included in the curriculum of Turkey as a sub-dimension of the STSE (MoNE, 2018). Although sustainable development took place in the curriculum and courses in universities, the fact that there were findings that are far from sustainable development in drawings and interviews may be because the students were not able to see this theoretical knowledge in real life.

Despite not being the main focus of the present research, scientists who made observation and research in nature in the drawings categorized as science-society-

environment came to the forefront. This finding contradicted the image of a scientist working alone in the laboratory, which was categorized as a stereotypical scientist by Camci-Erdogan (2019). This finding may be because science teacher candidates changed stereotypes that may exist in their minds about science and scientists. The fact that emphasis was given to the nature of science in the courses in science education programs and that they took a three-credit course about the nature of science may be effective in this change.

This research revealed that the vast majority of science teacher candidates consider the STSE relationship as a superficial relationship between the concepts of science, technology, society and environment. It was determined that the concepts of socioscientific issues, sustainable development, and the nature of science were indirectly included in the drawings and views of the students, although very few. It was seen that science teacher candidates predominantly made drawings and expressed opinions that showed the negative effects of technology on society and the environment and human on the environment.

In the light of these results, it can be suggested to organize learning environments where the STSE relationship can be learned more deeply by science teacher candidates. It can be recommended to develop sustainable development awareness within the scope of STSE and work towards real-life response. At the same time, it may be suggested to perform activities and practices to realize the relationship between socioscientific issues and sustainable development concepts with STSE.

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Fen Öğretmen Adaylarının Fen-Teknoloji-Toplum-Çevre İlişkisi Hakkındaki Görüşleri

Atıf:

Ozer, S., Kiray, S.A., & Cardak, O. (2021). Science Teacher Candidates' Views about Science-Technology-Society-Environment Relations. *Eurasian Journal of Educational Research,* 91, 83-104, DOI: 10.14689/ejer.2021.91.5

Özet

Problem Durumu: Modern insan günlük yaşamında sürekli olarak bilim ve teknolojinin olumlu ya da olumsuz etkileri ile karşı karşıya gelmektedir. Bilim ve teknoloji birbiri ile sıkı ilişki içerisindedir. Teknolojide gerçekleşen yenilikler, bilimdeki gelişmeleri, bilimdeki gelişmelerde teknoloji alanındaki yenilikleri etkilemektedir. Günümüz insanının hayatının her alanında var olan teknoloji, birçok alanda yeni bilimsel gelişmelere ve yeniliklere yol açmaktadır. Bilim ve teknolojinin birbirleri ile ilişkilerinin yanı sıra toplumla da yakın ilişkisi vardır. Bu nedenle Bilim-Teknoloji-Toplum birçok kaynakta bir arada yer alır. Fen-Teknoloji-Toplum yaklaşımı disiplinlerarası bir yaklaşımdır. Fen-Teknoloji-Toplum (FTT) yaklaşımına çevrenin de dahil edilmesiyle Fen-Teknoloji-Toplum-Çevre (FTTÇ) yaklaşımına dönüştürülmüştür. Bununla birlikte günümüzde FTT ve FTTÇ yaklaşımı birbirinin yerine kullanılmaya devam etmektedir. Bu yaklaşım bazı ülkelerin fen öğretim programlarında FTT, bazı ülkelerde ise FTTÇ şeklinde yer almaktadır. Bu araştırmanın verilerinin toplandığı Türkiye deki fen öğretim programlarında ve fen bilgisi öğretmenliği anabilim dallarındaki ders içeriklerinde FTTÇ yaklaşımı benimsenmiştir. Bu bilgiler ışığında bu çalışmada aşağıdaki sorulara cevap aranmıştır.

1- Fen bilgisi öğretmen adayları Fen-Teknoloji-Toplum-Çevre arasındaki ilişkiyi nasıl algılamaktadır?

2- Fen bilgisi öğretmen adayları FTTÇ yaklaşımını nasıl algılamaktadır?

Araştırmanın Amacı: Literatürdeki çalışmalar göz önüne alındığında FTTÇ yaklaşımının öğrenciler tarafından anlaşılması için öncelikle fen öğretmenlerinin farkındalığının olması gerektiği görülmektedir. Türkiye'de yapılan çalışmaların sonuçları FTTÇ yaklaşımının öğretim programlarında yer almasına rağmen öğrenciler ve öğretmen adayları tarafından tam kavranamadığına işaret etmektedir. FTTÇ yaklaşımının tam olarak öğretilebilmesi için fen-teknoloji-toplum-çevre kavramlarının birbiri ile ilişkisinin yanı sıra bu etkileşim ile ortaya çıkacak sosyobilimsel konular, sürdürülebilir kalkınma, bilimin doğası gibi yeni boyutlarında farkında olunması önem arz etmektedir. Bu çalışmada literatürdeki çalışmalardan farklı olarak FTTÇ bir öğretim yaklaşımı olarak ele alınmamıştır. Bunun yerine FTTÇ yaklaşımında yer alan fen-teknoloji-toplum-çevre kavramları arasındaki ilişkiyi fen öğretmen adaylarının nasıl algıladığı araştırılmıştır. Bu çalışmada FTTÇ yaklaşımını FTTÇ'yi oluşturan parçalar arası ilişkilerin yanı sıra bu parçaların kombinasyonu sonucu ortaya çıkacak farklı durumları da ele alması çalışmanın önemini artırmaktadır. FTTÇ'nin fen öğretmen adayları tarafından doğru ve derinlemesine öğrenilip öğrenilmediğini ortaya çıkartmak fen öğretmen adaylarının gelecekte bu öğrenme alanınına ait kazanımları öğrencilere kazandırmaları açısından önem arzetmektedir. Bu çalışmada fen öğretmen adaylarının FTTÇ yaklaşımını ve fen-teknoloji-toplum-çevre ilişkisini nasıl algıladıklarını araştırmak amaçlanmıştır.

Araştırmanın Yöntemi: Nitel araştırma türlerinden fenomenografik çalışma deseni kullanılan bu araştırmada fen bilgisi öğretmen adaylarının fen, teknoloji, toplum, çevre (FTTÇ) ilişkileri ve FTTÇ yaklaşımı hakkındaki algılarını ortaya çıkartmak amaçlanmıştır. Fenomenografik çalışma da birey ile öğrenme konusu arasında ilişki kurulmaya çalışılarak öğrenme ve düşünme bakımından bazı sorulara cevap aranmaktadır (Marton, 1986).

Araştırmanın çalışma grubunu 2018-2019 bahar döneminde Türkiye'de bulunan bir devlet üniversitesinde üçüncü ve dördüncü sınıfta öğrenim görmekte olan 145 fen bilgisi öğretmen adayı oluşturmaktadır. Fen bilgisi öğretmen adayların fen, teknoloji, toplum, çevre ilişkileri hakkındaki düşüncelerini ortaya çıkarmak için yapılan bu çalışmada veri toplama aracı olarak FTTÇ Testi ve görüşme kullanılmıştır. Araştırmada önce FTTÇ testi uygulanmış ve bu testten elde edilen bulguları güçlendirmek için daha sonra yüz yüze görüşmeler yapılmıştır. Bu iki veri birleştirilirken öğretmen adaylarının çizimleri merkeze alınmış ve bu çizimler üzerinden öğretmen adaylarının yaptığı açıklamalar, çizimlerden sonra doğrudan alıntı şeklinde verilmiştir.

Araştırmanın Bulguları: Fen-Teknoloji-Toplum-Çevre (FTTÇ) Kategorisi Fen bilgisi öğretmen adaylarının çizimleri incelendiğinde en çok çizimin fen, teknoloji, toplum, çevre kategorisi hakkında olduğu görülmektedir. Bu kategoride öğrenciler fen, teknoloji, toplum, çevre kavramlarının dördüne de kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrenciler çoğunlukla

çizimlerinde çevre olarak doğa ve canlıları ele almış, bilimsel araştırmalarda kullanılabilecek teknolojik aletlere ve günlük yaşamda kullanılan teknolojik araçlara yer vermişlerdir. Bu kategoride yer alan çizimlerde bilimsel araştırma yapılan ya da bilimsel araştırmaya ait simgeler içeren çizimler ön plana çıkmaktadır. Bazı çizimlerde pozitif mesajlar yer alırken bazı çizimlerde ise FTTÇ ilişkisi ile ilgili negatif mesajlar yer almaktadır.

Teknoloji-Toplum-Çevre Kategorisi: Fen bilgisi öğretmen adaylarının çizimleri incelendiğinde ikinci sırada teknoloji-toplum-çevre kategorisinin yer aldığı görülmektedir. Bu kategoride öğrenciler teknoloji, toplum, çevre kavramlarının üçünü kapsayacak çizimler yaparak aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrenciler çoğunlukla çizimlerinde teknoloji ve toplumun doğal çevreye ve canlı yaşamına zarar verdiğini göstermiştir.

Teknoloji-Çevre Kategorisi: Fen bilgisi öğretmen adaylarının çizimlerinden oluşturulan bir diğer kategori teknoloji-çevre kategorisidir. Bu kategoride öğrenciler teknoloji ve çevre kavramlarını kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrenciler çoğunlukla teknolojinin çevre üzerindeki olumsuz etkilerine odaklanmıştır.

Toplum-Çevre Kategorisi: Fen bilgisi öğretmen adaylarının çizimlerinden oluşturulan bir diğer kategori toplum-çevre kategorisidir. Bu kategoride öğrenciler toplum ve çevre kavramlarını kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Bu kategorideki çizimlerin tamamında öğrenciler toplumun çevreye zarar verdiğini göstermiştir.

Fen-Toplum-Çevre Kategorisi: Fen bilgisi öğretmen adaylarının çizimlerinden oluşturulan bir diğer kategori fen-toplum-çevre kategorisidir. Bu kategoride öğrenciler fen, toplum ve çevre kavramlarını kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrenci çizimlerinde çoğunlukla doğada araştırma ve inceleme yapan insan çizimleri ön plana çıkmıştır.

Tekoloji-Toplum Kategorisi: Fen bilgisi öğretmen adaylarının çizimlerinden oluşturulan bir diğer kategori teknoloji-toplum kategorisidir. Bu kategoride öğrenciler teknoloji ve toplum kavramlarını kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrenciler çoğunlukla çizimlerinde teknolojinin toplum yaşamını olumsuz yönde etkilediğini göstermiştir.

Fen-Çevre Kategorisi: Fen bilgisi öğretmen adaylarının çizimlerinden oluşturulan bir diğer kategori fen-çevre kategorisidir. Bu kategoride öğrenciler fen ve çevre kavramlarını kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrencilerin çoğunluğuna göre bilim araştırmaları için özel bir ortam şart değildir, doğada da bilim çalışmaları yapılabilir.

Fen-Teknoloji-Toplum Kategorisi: Fen bilgisi öğretmen adaylarının çizimlerinden oluşturulan bir diğer kategori fen-teknoloji-toplum kategorisidir. Bu kategoride öğrenciler fen, teknoloji ve toplum kavramlarını kapsayacak şekilde çizime yer vererek aralarındaki ilişkiyi göstermeye çalışmıştır. Öğrenciler çoğunlukla çizimlerinde fen ve teknolojinin toplum hayatına olumlu etkisini göstermiştir.

Araştırmanın Sonuçları ve Öneriler: Bu araştırma fen bilgisi öğretmen adaylarının çok büyük çoğunluğunun FTTÇ ilişkisini fen-teknoloji-toplum ve çevre kavramlarının yüzeysel olarak birbiri ile ilişkilendirmesi olarak ele aldığı ortaya çıkmıştır. Çok azda olsa öğrencilerin çizimlerinde ve görüşlerinde FTTÇ kavramı içerisine dolaylı olarak sosyobilimsel konular, sürdürülebilir kalkınma ve bilimin doğası kavramlarının yer aldığı tespit edilmiştir. Fen bilgisi öğretmen adayları ağırlıklı olarak teknolojinin toplum ve çevre üzerindeki ve insanın çevre üzerindeki olumsuz etkilerini ortaya koyan çizimler yaptıkları ve görüşler belirttikleri görülmektedir. Bu sonuçlar ışığında FTTÇ ilişkisinin fen öğretmen adayları tarafından daha derinlemesine öğrenilebileceği öğrenme ortamları düzenlenmesi önerilebilir. FTTÇ'nin kapsamında yer alan sürdürülebilir kalkınma bilincinin geliştirilmesi ve gerçek yaşamda karşılık bulmasına yönelik çalışmalar yapılması tavsiye edilebilir. Aynı zamanda sosyobilimsel konuların ve sürdürülebilir kalkınma kavramlarının FTTÇ ile ilişkisinin farkına varılmasına yönelik etkinlikler ve uygulamalar yapılması önerilebilir.

Anahtar Sözcükler: Fen-Teknoloji-Toplum-Çevre, FTTÇ, FTTÇ farkındalığı