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INVESTIGATION OF THE PROSPECTIVE SCIENCE TEACHERS' VIEWS ON THE PROBLEMS AND SOLUTIONS REGARDING SCIENCE AND TECHNOLOGY

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Abstract: The aim of this study was to investigation of the prospective science teachers' views on the problems (as are the waste of natural resources, the information pollution, sharing information without confirming their validity of information, communication problems among people, spending extra time and money, the laziness, the obesity, the environmental pollution, the global warming etc.) and solutions regarding science and technology. Research method of this study was case study method. The four second year prospective science teachers attending education faculty of a state university were participated to this study. The data tools of this research were used questions in focus group interviews. The data obtained from the focus group interviews were analyzed using content analysis method. According to the results obtained from this study, prospective science teachers were expressing many problems within the framework of individual, social and environmental on science and technology sourced problems. Considering the results obtained from this study, it can be said that the solutions suggested by the prospective science teachers to solve the science and technology sourced problems are limited and can be improved.

Key words: Problems Regarding Science and Techonology, Prospective Science Teachers, Science Education, Solutions

1. Introduction

Affecting almost every aspect of our daily life, science can be regarded as an integral part of our life. Defined in different ways, science is seen as a discipline which attempts to understand, figure out, and explain the events happening in the physical and biological environment in order to produce new knowledge (Çepni, Ayas, Akdeniz, Özmen, Yiğit & Ayvacı, 2007; Hastürk, 2017). From the very first moment of their existence on the earth, people have produced new information through science with the motivation to survive and make their lives easier and made the first technological inventions including wheels, rafts and knives using this information (Hastürk, 2017). Thus, in line with the advancements in technology, science was able to advance as well. Science and technology have a reciprocal relationship. However, contrary to what most people think, technology does not equal to machines only. It also refers to the information and the processes required designing, building and operating these machines (Young, Cole & Denton, 2002). In brief, technology is the systematic application of organized information or scientific information by using the skills gained as a result of people's efforts to dominate nature (Alkan, 1998; Galbraith, 1967; İşman, 2001).

There are problems arising in parallel to the innovations experienced in our age in which rapid scientific and technological advances take place. These problems have adverse effects on human life, which have persisted for a long time so far. According to Bakar, Keleş and Koçakoğlu (2009), globalization, international economic competition, and rapid scientific and technological advances will continue to affect our lives in the future. Digitalization, energy and security problems, which started especially with the internet revolution and continued with the social media and mobile revolution, are important problems concerning humanity (Ertemel & Eroğlu-Pektaş, 2018; Özcan, 2011; Rosidin & Suyatna, 2017). In addition, various environmental issues, such as the depletion of the ozone layer, the greenhouse effect and the long-lasting drought, are problems created by humans (Baykal & Baykal, 2008). Among them global warming is the most current and urgent problem (Demirbaş & Pektaş, 2009; Kovancılar, 2001 as cited in Ünlü, Sever & Akpınar, 2011). Developing an understanding about

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these issues, which can be defined as science and technology sourced problems, will give individuals superiority in terms of adapting to the age and changing conditions (Laugksch, 1999). In this context, students should be aware of science and technology sourced problems. Thus, they can become individuals beneficial to their countries by investigating the reasons under the events, questioning them and producing possible solutions to these problems (Bakar, Keleş & Koçakoğlu, 2009).

When the relevant literature is examined, it is seen that there are studies investigating prospective teachers' awareness about renewable energy (Çelikler & Kara, 2011), their views and misconceptions about the greenhouse effect (Arsal, 2010; Bal, 2004; Ikonomidis, Papanastasiou, Melas & Avgoloupis, 2012), their views and perceptions about the concept of global warming (Ambusaidi, Boyes, Stanisstreet & Taylor, 2012; Demirkaya, 2008), the relationship between their perceptions about depletion of ozone layer and global warming (Tüzün & Yanış, 2010), their information and perceptions about genetically modified organisms (Kaya, Gürbüz & Derman, 2012; Sorgo, Ambrožič-Dolinšek, Uşak & Özel, 2011), their views about the benefits and risks of nuclear and thermal energy (Aksan & Çelikler, 2018; Ateş & Saraçoğlu, 2013), and their views about internet and digital game addiction (Karademir-Coşkun & Filiz, 2019; Karaman & Kurtoğlu, 2009). Moreover, there are scale development studies which aim to measure prospective teachers' perceptions regarding renewable energy sources (Güneş, Alat, & Gözüm, 2013), their awareness about renewable energy (Morgil, Seçgen, Yücel, Oskay, & Ural, 2006), effective use of energy and technological pollution (Okur & Yalçın-Özdilek, 2013), and genetically modified organisms (Güney, 2018).

According to the Turkish national science education curriculum, it is aimed to enable students to handle problems with an interdisciplinary perspective by integrating science into mathematics, technology and engineering (Milli Eğitim Bakanlığı [Ministry of Education] [MEB], 2018). Therefore, science teachers have important responsibilities in terms of teaching essential concepts to and raising awareness among students about science and technology. Thus, an elective course called "Science and Technology Sourced Problems" was added to science education curriculum (Yükseköğretim Kurulu [Council of Higher Education] [YÖK], 2018). Robinson, Tibanyendera and Seltzer-Kelly (2007) suggest that prospective teachers need much more of the content and pedagogy knowledge to help effectively their future students develop favourable worldviews and attitudes towards environmental problems and/or threats. In this regard, it is very important for prospective science teachers to be knowledgeable about the problems in the field of science and technology and to propose solutions to these problems. When the related literature is reviewed, no studies were encountered which deal with science and technology sourced problems and possible solutions comprehensively". The aim of this study was to investigation of the prospective science teachers' views on the problems (as the waste of natural resources, the information pollution, sharing information without confirming their validity of information, communication problems among people, spending extra time and money, the laziness, the obesity, the environmental pollution, the global warming etc.) and solutions regarding science and technology. In line with this purpose, the present study aimed to answer the question:

"What are the prospective science teachers' views on problems and solutions regarding science and technology?"

2. Method

This study was used case study research method. Case study research method is a qualitative research design in which one or several cases bounded in time are analysed in-depth through data collection tools of multiple sources (observations, interviews, audio-visuals, documents, reports) in order to define situations and situation-based themes (Creswell, 2007). In the present study, prospective science teachers' views about science and technology sourced problems and possible solutions were considered as a case and it was tried to obtain in-depth information about this case.

2. 1. Participants

Participants of the study were selected based on voluntariness. Four out of seven prospective science teachers voluntarily participated in the study. Participants were second year students attending

education faculty of a state university. Two of participants were men (İlhan, Kadir) and other two were women (Sema, Sevim).

2. 2. Data Collection

Research data were collected using focus group interviews. Focus group interview is a qualitative data collection method in which in-depth information is obtained through a discussion and an unstructured interview in a well-planned environment where individuals can plan their thoughts freely by using the effect of group dynamics (Merriam, 2013; Yıldırım & Şimşek, 2013). Focus group interviews are one of the most effective qualitative data collection methods and in-depth, detailed and multidimensional data can be collected with group dynamics (Yıldırım & Şimşek, 2013). In contrast to one-to-one interviews, individuals express their own opinions in the focus group interview, while listening to the opinions of other individuals allowing them to express different views. Science and technology sourced problems are intertwined with one-to-one daily life. One of the appropriate interviews with topics related to daily life is the focus group interview (Merriam, 2013). In the focus group interviews, a single status and scheduled conversation should be provided according to the situation (Merriam, 2013; Yıldırım & Şimşek, 2013). For this reason, two focus group interviews were conducted separately at different times on the situation of "science and technology sourced problems" and "solutions to science and technology sourced problems". A week after the first focus group interview, the second focus group interview was made. Two focus group interviews were conducted in the research. “The science and technology sourced problems” were given as the topic of discussion in the first focus group meeting and the interview lasted approximately 35 minutes. In the second focus group meeting, prospective science teachers asked to propose possible solutions to the science and technology sourced problems, which lasted approximately 25 minutes. During the focus groups, interviews were recorded using a voice recorder. During interviews prospective science teachers used the nicknames given by themselves while expressing their thoughts and before expressing their thoughts, they said their nicknames first.

2. 3. Data Analysis

The data obtained from the focus group interviews were analysed using content analysis method. During the data analysis process, firstly, two researchers came together to determine common themes. Then researchers worked independently to explore the main ideas in the themes. Finally, the analysis was completed after reaching a consensus on the discrepancies during the independent content analysis by two researchers. As a result of the analysis of the data obtained from two focus group interviews, three major themes were explored called Social, Individual and Environmental. These themes were created according to the social, individual and environmental level of problems and solutions. Main ideas were created by bringing together the similar opinions in the themes. The statements of participating prospective teachers regarding these main ideas were given in the research report.

3. Finding

The data obtained from the focus group interviews on science and technology sourced problems were examined within the framework of three themes including Individual, Social and Environmental problems.

3. 1. Social Problems

Prospective science teachers think that increased mechanization in production as a result of technological developments have reduced employment opportunities in factories, the job seekers have become poorer as the employers become richer, and thus the rate of middle income families have decreased and the income inequality in the society has increased, information is shared very fast without confirming its correctness, children play digital games more on devices such as computers instead of physical games (e.g. street games) and they suffer social communication problems.

> ***İlhan:*** *With the development of technology, people's lives became easier and doing many jobs became easier, too. This situation causes some unavoidable damages. To give an*

example for these damages, in the past everything was done by work force, but now the employment rate has reduced as many automation devices are used instead of worker in factories. This has led to unemployment. It has become difficult for many people to find a job. This has caused financial difficulties for individuals in supporting their families. This resulted in the rich factory owners getting richer and ordinary citizens getting poorer.
Sema: *Families are classified into two according to income status: the rich and the poor. There are no middle income families anymore.*
İlhan: *Not all the information we access are correct. There is a lot of information pollution. We have to approach these situations with critical thinking.*
Kadir: *Regarding this issue, people are now misunderstanding each other. What you want to say may not be understood correctly. Also, false information can spread very quickly. In the past, although it was wrong, our country was announced to have won a competition -I think it was Expo 2016-, which was spread rapidly and even celebrated.*
İlhan: *This situation also causes problems in terms of socialization. Initially used for information purposes, computers are now used mainly for entertainment purposes. Children no longer go out to play games on the streets. Everyone plays games on devices such as tablets and computers. Children grow up in an apartment only.*

Prospective science teachers stated that the problems related to communication, social life and family relations are caused by digitalization, telephone and social media. They also stated that spending too much time on the phone cause communication problems between people due to digitalization, and social media cause people not to experience real life.

Kadir: *The phone wastes most of our time. We spend a very long time with technology. Maybe it is driving us away from other things. This is a big problem for us.*
Sevim: *We cannot simply consider this event as a matter of unemployment or wealth-poverty. There are also other problems including polluting the world, negatively affecting people's psychology, and communication problems between people due to excessive digitalization. Our world is polluted - like air pollution- due to the factories and mechanization.*
Kadir: *Another problem is that people do all their work with phones people and spend most of their time on social media. In this case, although he enjoys the ease of technology, he may be isolated from the real life outside.*

The prospective science teachers stated that the armament and armaments race is the main source of the increase in human deaths and the financial problems of countries. They also stated that due to the use of technology and chemical weapons, human deaths increased, and countries had to allocate financial resources for armaments race, which adversely affects the economy and people die because of the experimental use of the new weapons produced.

Kadir: *... There is also the issue of armament. Technology is good, people can communicate with each other, devices are functioning better; but they also have huge drawbacks. I can show the example of Hiroshima-Nagasaki. Thousands of people disappeared suddenly. Chemical armament is a reality.*
İlhan: *Countries are somehow in a race of armament. They always give the message "I have the most powerful weapons, the most powerful tools and equipment." Considering the wars in the past, there were swords and shields. Even stones and sticks. Thus, the number of people who died in a war was evident. ... But today, when countries produce weapons, they also want to try them: "I made this weapon, but how effective?" And thus, they create civil disturbance in many countries, as we actually witness now around the world. They look for an opportunity to test their own weapons. They do experiments on people. So many people are dying.*

3. 2. Individual Problems

Prospective science teachers stated that because of technology people became lazy, they cannot learn the information permanently, they fail to question and think critically, they take extra time and money to prevent physical problems, and they cannot criticize themselves. To put it more precisely, they

asserted that since the children play computer games instead of physical games people get lazier; as people easily access and look over the information, they cannot retain new information; they are prevented from questioning and critical thinking; since they get inactive as a result of the comfortable life eased by all technological means, people have to spend extra time and money to do sportive activities; since there is excessive amount of information exchange through technology, individuals accept only the information that supports their views and claim that their views are always true, instead making self-criticism. In addition, the prospective science teachers have stated that people trust people they do not know as the cause of social media problems.

> ***Sema:*** *Using technology, we can now access information more easily. This convenience makes lead us forget the information easily. We are getting lazier as we do not effort as necessary.*
> ***İlhan:*** *All the information we access is not necessarily correct. There is a good deal of information pollution. ...*
> ***Sema:*** *It prevents people from questioning and critical thinking.*
> ***Sevim:*** *Regarding laziness, it also causes physical laziness. This also causes obesity, since we can do everything just sitting and without even moving. We are not tired, but this damages our physical health in other ways. To prevent this situation, gymnasiums are opened every day. Thus, we spare time for an additional effort.*
> ***İlhan:*** *We understand only what we want to see, what we want to understand. Even if the ten sentences we read on social media are contrary to our idea, we concentrate on the eleventh sentence that agrees with our idea. In this way we believe that our opinion is correct because it is supported.*
> ***Sema:*** *Another problem is about finding friends on social media. You have to trust people you never know.*

Prospective science teachers think that the problems that affect people's health are caused by genetically modified foods and preservatives added to processed food. They stated that human health is adversely affected by modifying the genetics of foods and using preservatives to extend their shelf life. They also stated that the purpose of using preservatives is mainly to make more money.

> ***Sema:*** *Not only in agriculture; fruits, vegetables, even the milk we buy are genetically modified … While the natural milk from a cow lasts 1-2 weeks, the milk we buy from a market can last for 1 month. It is doubtful how beneficial it is to our health… How much has it been genetically modified so as to extend its life so much?*

> ***İlhan:*** *In my opinion, human health is not the priority, because all the preservatives and additives are used only to make more profit. So how much does everything we buy from the market bring income to the factory? The less expense you make, the more money you make? So many things are unhealthy. They write expire dates as long as six months or a year for products which would naturally spoil in two days.*

> ***Sevim:*** *We are in winter, we need to get vitamin C. You buy fruit from the markets, however are they really healthy? Do I really buy it because it is useful? For example, the orange and vitamin C. It needs to be useful, but is it really useful? I think on it so much.*

> ***Sema:*** *Yesterday, I saw strawberries in a greengrocer in December. I was very surprised… how can it be possible?*

Prospective science teachers stated that the source of the problems affecting the human health is artificial cells and drug production. They stated that artificial cells and drug production tests give harm to the subjects they are applied.

> ***Kadir****: Artificial cell is another issue. ... Some diseases can be cured; but they also give damages.*
> ***Sevim:*** *I saw that an ear was grown on an animal. It is now possible to transplant an artificial organ to a person who has lost his ear. This is nice, but also risky.*
> ***Kadir****: If the artificial ear does not function after generating and integrating it into human, these processes are good for nothing.*

***İlhan**: This is true for many pharmaceutical industries. Is it correct to use animals in drug production? For example using mice, it is a pity for them? They are also living creatures.*
***Sevim**: In these cases, specially produced laboratory mice can be used. Scientists first produce mice for their experiment, and practice on these mice.*
***İlhan**: Does it mean that when produced they are not alive?*
***Sevim**: I think it doesn't mean the same because it is produced for a special purpose.*
***İlhan**: There is already the practice of testing drug effects in exchange for money. People are also used.*
***Kadir**: Although good amount of money is earned in this business, it gives harm to living things. The mice are killed.*
***Sevim**: Yes, but this is a dilemma. The mice are hurt; however these processes must be tried on mice instead of humans, which are the closest to human genetics and can reproduce quickly. Trying on people would cause worse results. We face a dilemma. What can we do other than trying them on mice?*
***Kadir**: What if the results from mice do not achieve the same effect in humans? This is also a risk.*
***İlhan**:… We use drugs, but it is questionable how much it heals us. … We install antivirus programs on our computers. Who produces these viruses? They produce a new virus?*
***Sema**: The same was said when the swine flu first came out.*
***İlhan**: Yes. First the swine flu appeared, and then its vaccine was released.*
***Sema**: In fact, they introduce a disease through a virus and then they heal it only to make a profit.*
***Kadir**: Although science and technology definitely have pros, they also have also cons. They can be said to cause more problems than positive things.*

3. 3. Environmental Problems

Prospective science teachers stated that the environmental pollution, depletion of natural resources and global warming problems are all caused by factories and mechanization. They stated that the air pollution caused by factories and mechanization polluted our world, the paper factories destroyed the forests, the building factories in forests outside the city destroyed the forests, the use of underground water resources by industries will deplete water supplies, and global warming is caused by environmental pollution and environmental damage. They also stated that the melting of glaciers as a result of global warming would lead to increased diseases.

***Sevim:** We cannot simply consider this event as a matter of unemployment or wealth-poverty. There are also other problems including polluting the world, negatively affecting people's psychology, and communication problems between people due to excessive digitalization. Our world is polluted - like air pollution- due to the factories and mechanization.*
***İlhan:** If we give the paper factories as an example, our forests are being destroyed to produce paper. Since the factories cannot be established in residential centres, they are established outside the city. These regions are mostly forested areas. Forests are burned and destroyed.*
***Sevim:** Yes. We are somehow depleting the world.*
***İlhan:** There are certain raw materials used by factories, including oil, coal etc. They use underground mines. These will run out one day in the future.*
***Sema:** Global warming is another issue. I had read something on this subject. Many disease viruses preserved in glaciers are released when they melt as a result of global warming. Thus, these diseases can reappear with melting and the public health can be adversely affected again.*

The prospective science teachers stated that the pesticides damage living things and cause the outbreak of diseases. They explained that the main purpose to use pesticides is to give a better appearance to

fruits and vegetables and extend their shelf life. They also stated that chemical armament negatively affects the environment in the long run and will continue to threaten people's lives.

> ***Sevim:*** *Pesticides are used to ensure that the crops last longer, their shapes look more attractive, and their consumption data lasts longer. However, this gives harm to living creatures. Therefore, many diseases outbreak.*
> ***Kadir:*** *Ancient people used to fight with stones and sticks, which killed only the people there and then. However, with the use of chemical weapons today, the effects of wars continue many years after the war ended. For example, the radiation. Even our country has been affected by these chemical weapons.*

The data obtained from the focus group interviews on prospective teachers' proposals for the solutions of the science and technology sourced problems were examined within the framework of three themes including Individual, Social and Environmental solutions.

3. 4. Social Solutions

To solve the science and technology sourced problems, prospective science teachers proposed the development of projects by people in cooperation with public institutions (e.g. municipalities) for water saving and recycling in the areas where water is widely used. In addition, they suggested solutions based on prioritizing human health and sustainability during production processes.

> ***Sema:*** *I have recently learned that the water is consumed the most in clothing production. Tons of water is wasted for a sweater. Therefore, we should save not only in water itself but also in areas where water consumption is high. I believe this could be more beneficial.*
> ***İlhan:*** *We should also practice recycling effectively. In cooperation with the municipality, everybody should establish and effective recycling system at home.*

To solve the science and technology sourced problems, prospective science teachers proposed that new topics about how to struggle against science and technology sourced problems should be integrated into the national curriculum to raise awareness among students, individuals should be educated before they become parents so that conscious parents can educate their children about these issues during the preschool period, and the society should became aware of the importance of adopting healthy organic agriculture.

> ***Sema:*** *We should be able to do something individually so that we can adapt it to society next. As the society becomes conscious, the country gradually becomes fully conscious. We have to disseminate this understanding to the majority of the society.*
> ***İlhan:*** *The more a teacher teaches this subject in the classroom, the more conscious the students, especially the young children, become. When these children grow up and become parents, the society will become much better. Everyone should raise their own family and child in this way.*
> ***Sema:*** *Even without starting a family, with the education given in schools, the families of the children can become conscious. When the children tell their parents about these awareness-raising activities at home, parents may also become conscious.*
> ***Sema:*** *Parents can be effective until the children start school, where the teachers can be more effective than.*
> ***İlhan:*** *Especially middle school students listen to their teachers more than they listen to their families. When the teacher tells the students to save, the children actually practice it.*
> ***Sevim:*** *Additionally, seminars and meetings can be organized to raise awareness among families. The child is growing up in the family, and thus the families should be aware foremost.*
> ***Kadir:*** *Teachers should mention about all these in their lessons.*
> ***Sema:*** *Car brands can ignore the human health for the sake of new designs. However, I heard of a car brand, which aimed to make new designs giving importance to human health and sustainability first putting everything aside. I heard that cars of this brand*

have an airbag for the pedestrian in case of an accident. Thus, the pedestrian is not hurt in case of a collision. Number of such designs should be increased.
İlhan: *… We should to prefer alternative energy. We have just talked about agriculture, we live in an agriculture country; but now we import most of the products. Awareness raising activities should be conducted to promote healthy and organic farming. We can be self-sufficient.*

To solve the problems related to science and technology, prospective science teachers suggested that countries should develop policies based on human health and abide by the international agreements regarding environment instead of postponing them in order to reduce the impact of global warming.

Sevim: *Our country should also consider its citizens in this case. Human health should be cared rather than consumption. Bosses should do things to improve public health.…*
Sema: *There was the idea of fixing at the global worming at 1.5 degrees for countries. Countries set a common goal with the idea that global warming could not be prevented but its effect could be reduced. There was a restriction for all countries about the amount of the gases released into air; however, some developed countries withdrew from this decision and the idea was cancelled. Instead of cancelling these ideas, efforts should be made to comply with such decisions.*

3. 5. Individual Solutions

For the solution of science and technology sourced problems, prospective teachers suggested that people should make individual savings and do shopping according to their needs. They also suggested that in addition to the incentives provided by the state, people should be directed to engage in agriculture individually.

İlhan: *Just as when everyone clears their front deck in a small village, the whole village will be clean, we should start from ourselves to solve these problems. For example, turning off the water while brushing our teeth, saving water by using dishwasher when washing dishes or not making unnecessary shopping are some of the things we can do individually. While we have 4-5 pairs of shoes, we should not buy new ones saying that these are outdated. So we can save on ourselves.*
Kadir: *People are coming from east to west now. I do not know if the government has enough incentives for them. But still everyone wants a comfortable life. They find it difficult to produce.*
Sevim: *I am from Rize. Now the number of people growing tea plants has decreased drastically. The state constantly provides financial incentives for this. But now almost everyone prefers moving to cities, nobody wants to earn their lives with agriculture and livestock. That being the case, organic farming has finished and we are making loss.*

3. 6. Environmental Solutions

To solve the problems related to science and technology, prospective teachers suggested that renewable energy sources should be preferred against the danger of the exhaustion of natural resources and the global warming, production methods that do not harm the environment should be used (e.g., increase in the production and use of electric cars), factories should be inspected to use filtering systems in order to prevent environmental damages.

Sema: *We can prefer renewable energy sources in response to the depletion risk of these resources in the future. We can use wind as a source of energy, or we can try ways to reduce energy use. For example, we insulate our homes to reduce the energy loss.*
Sema: *In my opinion, to solve the global warming as one of these problems, renewable energy sources can be used to make energy savings.*
Kadir: *Electric cars do not harm the environment. Incentives about the use of electric cars can be made in our country.*

İlhan: *In addition to these, existing facilities in our country can be improved. For example, factories can be equipped with filter systems. Factory audits should be done accurately.*

4. Conclusions, Discussion and Recommendations

This study investigated the prospective science teachers' views on problems and possible solutions to these problems (as are the waste of natural resources, the information pollution, sharing information without confirming the validity of information, communication problems among people, spending extra time and money, the laziness, the obesity, the environmental pollution, the global warming etc.) regarding science and technology. In this section, the results regarding the problems, the sources of the problems and the possible solutions to these problems are discussed according to the relevant literature by analyzing the findings obtained from focus group interviews according to certain themes

According to the findings obtained from the focus group interviews with prospective science teachers, science and technology sourced problems included the decrease in job opportunities, the increase in income inequality in the society, sharing information without confirming the validity of information, spending too much time with technological devices, the communication problems among people, the failure to live a real life, the increase in laziness and communication problems as a result of children playing games on devices such as computers, the allocation the financial resources in countries' armament, the increase in human deaths, the failure to learn information permanently, avoiding questioning and critical thinking, spending extra time and money, the failure to make self-criticism, deterioration of human health, the passion to earn more money, giving harm to living things, developing excessive self-confidence, environmental pollution, the depletion of natural resources, global warming, the increase of diseases, and the negative impact on our environment in the long run. According to the results obtained, it can be said that the participating prospective science teachers are aware of most of the problems related to science and technology. Similar results are also reported by studies in the relevant literature (Aksan & Çeliker, 2013; Ertemel & Eroğlu-Pektaş, 2018; Kanat, 2019; Kaya, Gürbüz & Derman, 2012; Kışoğlu & Keleş, 2018; Kortland, 1996; Topçu, Sadler & Yılmaz-Tüzün 2010; Türkmen, Pekmez & Sağlam, 2017; Walker & Zeidler, 2007).

According to focus group interviews conducted with prospective science teachers, the source of problems include the advancement of technology (e.g. factories, mechanization), the use of electronic and automation devices as a result of the advances in technology, the increased use of technological devices for entertainment purposes, digitalization (information sharing areas, information transportation facilities, telephone, internet, social media etc.), armament (e.g. arms race, personal armament, chemical armament), transgenic organisms (genetically modified foods and genetically modified organism [GMO]), preservatives, artificial cells, drug production and agriculture (pesticides, chemicals used in agriculture). Based on the results obtained, it can be said that participating prospective science teachers are partially aware of the sources of science and technology sourced problems. Similar results are seen in studies in the related literature. Similar results are also reported by studies in the relevant literature (Aksan & Çelikler, 2013; Ertemel & Eroğlu-Pektaş, 2018; Kanat, 2019; Kaya, Gürbüz & Derman, 2012; Kışoğlu & Keleş, 2018; Türkmen, Pekmez & Sağlam, 2017; Walker & Zeidler, 2007).

In a previous study, Zorlu and Baykara (2015) reported that prospective science and classroom teachers stated that technology have negative effects on the society. In his study Ertemel ve Eroğlu-Pektaş (2018) found that university students spend excessive time on the phone (mobile internet), and do not fully experience the real world. In their study, Aksan and Çelikler (2013) reported that prospective teachers stated that global warming is a problem and environment, air, water and soil pollution are among the top four of the environmental problems threatening the world. In a previous study, Kışoğlu and Keleş (2018) concluded that prospective science teachers perceive GMO as harmful to human health. In their study, Kaya, Gürbüz and Derman (2012) concluded that university students think that genetically modified products have negative effects on people and the environment. Türkmen, Pekmez and Sağlam (2017) found that prospective science teachers think that technology negatively affects social life and causes environmental pollution and obesity. In their study, Dilek-

Eren, Muşlu-Kaygısız and Benzer (2018) reported that the prospective teachers stated that the atom bomb (e.g. armament) had a negative effect on peace and that the technology was used mainly for the purpose of armament and war. It is apparent that in similar studies prospective science teachers generally expressed negative effects of cloning, global warming, nuclear power plants, genetically modified organisms, waste control and recycling (Demircioğlu & Uçar, 2014; Kortland, 1996; Topçu, Sadler & Yılmaz-Tüzün 2010; Walker & Zeidler, 2007).

According to the results of the research, it can be said that participating prospective science teachers think that science and technology sourced problems are generally caused by excessiveness, failure to use technology properly, using it mostly for entertainment purposes, failure to prioritize human health, passion to make more money, and failure to protect the environment. Computers, mobile phones and the internet, which have been introduced to our lives with the advancement of technology, have become indispensable. Excessive use of computers, mobile phones and the internet, using them for entertainment purposes only and wasting most of our time are problematic. The habit of playing digital games negatively affects our cognitive, psychological and social life. It can be said that this situation is most common among children and young people, which causes laziness, obesity, lack of communication and socialization, and avoidance from questioning and critical thinking (Kanat, 2019; Türkmen, Pekmez & Sağlam, 2017). At the same time, the alternative media used to share information have gradually increased, but while we receive the information, we accept the information without making self-criticism or we only accept the information in accordance with our opinion. Today, information is shared on the internet, e.g. through websites or social media. Internet and websites have become very common and most of them are available to individuals. The prejudices of students or individuals who evaluate the content of the websites affect how they see the site. Everyone has their own beliefs, values, and ideas. When we search on the net, we can naturally accept the sources as the only authority because they provide information in support of our point of view, while we may reject the more reliable primary sources just because they are against our point of view. Therefore, we should be aware of our bias when evaluating websites. Teaching students to evaluate the content of websites is intended to teach critical thinking (Keskin, 2015). According to the results obtained from the research, participating prospective science teachers emphasized that problems arise because human health and environment awareness are neglected.

According to the findings obtained from the focus group interviews, within the theme of social solutions, the prospective science teachers suggested to solve the science and technology sourced problems by saving water in the fields where water is used more, developing projects where people can cooperate with public institutions (e.g. municipalities) for recycling, prioritizing human health and sustainability in the production process. In adition to the prospective science teachers suggested to integrate science and technology sourced problems and things to do in national curriculum to raise awareness among students, educating individuals before they become parents so that conscious parents can educate their children about these issues during the preschool period. In adition to the prospective science teachers suggested to putting them into practice instead of postponing the decisions taken by countries in order to reduce the impact of global warming, raising awareness among the society for the development of healthy organic agriculture, and developing policies toward public health.

Under the theme of individual solutions, prospective science teachers proposed that people should make savings individually, do shopping according to their needs and they should be encouraged to engage in agriculture individually in addition to the incentives given by the state. Moreover, under the theme of environmental solutions, prospective science teachers proposed that renewable energy resources should be preferred against the danger of the exhaustion of natural resources and the global warming, environmental-friendly production methods should be used -for example electric cars should be produced and used more commonly, factories should be inspected not to give harm to the environmental. Considering the results obtained from this study, it can be said that the solutions suggested by the prospective science teachers to solve the science and technology sourced problems are limited and can be improved.

When it comes to what the prospective science teachers proposed to solve the science and technology sourced problems through science education, it is seen that participants proposed such actions including the integration of these topics into the science education curriculum, providing the science

teachers with education on these issues, and giving due consideration on these issues in the lessons. They also mentioned that teachers should be in cooperation with the parents and parents should be educated on these issues. It is believed that the teachers play an important role in preventing chemical weapons and wars, and in securing peace with cooperation in the world (Whitney, 1981). Therefore, science and technology related problems should be integrated into national science education curriculum at primary, secondary, high school and university level (Sadler & Zeidler, 2004). Raising social awareness among individuals and society is important in terms of education of science and technology sourced problems (Albe, 2008; Lester, Ma, Okhee & Lambert, 2006). It is also important to consider the discussions about ethical and moral values and the opinions of different stakeholders (e.g. personal interest, society, political authorities, etc.) in teaching science and technology sourced problems (Simonneaux, 2011). In this respect, while teaching science and technology sourced problems, cooperation can be achieved by asking the opinions of all stakeholders in the society. Integrating these issues in the teacher training programs will also contribute to the teaching of these issues (van der Zande, 2011).

According to the findings of the research, prospective science teachers emphasize that people should take initiatives to solve the problems related to science and technology in addition to what the state has done so far or plan to do in the future. It is important that individuals should strive themselves to reduce adverse effects of problems caused by science and technology instead of expecting everything from the state. We should bear in mind that the world is ours and next generations!

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