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Metaphorical perceptions prospective teachers towards socioscientific issues

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Abstract

In this study, it is aimed to determine the metaphorical perceptions of prospective science, social studies and classroom teachers towards socioscientific issues. The study was carried out with third and fourth class prospective science (f: 41), classroom (f: 129), and social studies (f: 73) teachers of the faculty of education at a state university in the Central Black Sea region in Turkey in 2019-2020 academic year. In the study, the forms of metaphors including eight socioscientific issues such as nuclear power plants, artificial intelligence, genetically modified organisms, organ transplantation, surrogate motherhood, global warming, stem cells and cloning were used as data collection tools. The prospective teachers enrolled in the study group were given the forms which were written an expression like "The artificial intelligence is like… …… ……because……..." to collect data as "documents" in the study. Content analysis was used in data analysis. As a result of the study, the students created 42 metaphors about nuclear power plants, 31 about artificial intelligence, 26 about organ transplantation, 29 about surrogate motherhood, 30 about genetically modified organisms, 23 about global warming, 28 about stem cells and 21 about cloning, and they created categories for each concept. In the light of the findings, the importance of socioscientific issues was emphasized and suggestions were made for program determinants, researchers and practitioners regarding teaching.

Keywords: Socioscientific Issues, Prospective Teachers, Metaphor.

1. Introduction

Science, a discipline trying to understand, to make sense and to explain daily life events, cannot be isolated from the society to which they belong. Each individual understands and interprets scientific ideas and information while solving problems and making decisions. One of the important aims of science education is to teach and understand socioscientific issues that take their content and subject from situations and events that individuals may encounter in daily life (Albe, 2008; Kolsto, 2006; Nielsen,

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2012; Walker and Zeidler, 2007). There is always an interaction between science and society, and the effect of the interaction continuous in the same way. The effect of science on society and the development of science with the impact of society's needs is seen from past to present. The rapid change in the scientific field has begun to be felt in social life every day and has caused many debates and dilemmas in society. For example there are people who support this by considering the effect of genetically modified organisms (GMOs) on the production of more efficient, tastier and longer shelf life plant and animal source foods while there are also people who oppose GMOs by considering that it will have a negative effect on human health. Likewise, while some segments of the society show a positive attitude towards surrogate motherhood, some people have a negative attitude towards this issue. As can be seen from the examples, socioscientific issues (SSI) are mostly open to discussion, complex, and without a definite answer (Sadler, 2004; Sadler, 2006; Topçu, 2011). Sadler (2004) expressed socio-scientific issues as complex and open-ended dilemmas about the environment, health, society and economy that require multiple perspectives and do not have precise solutions. Zeidler and Nichols (2009) defined socioscientific issues as follows: issues such as nuclear power plants, surrogate motherhood, GMO-containing foods, organ transplantation and artificial intelligence studies have been on the agenda for about the last quarter century, and this has shown that science has entered a process especially to meet social needs. In this way, it is called as scientific issues that have social dimensions, are open to debate, and are not clear how to make decisions with constant evidence.

Ratchliffe and Grace (2003) listed the general features of SSI as follows:

- Having media coverage
- Being from life and being on agenda
- Developing within the framework of scientific knowledge
- Requiring making choices and developing ideas as individuals and as a society
- taking science as a center
- Containing moral reasoning and values
- Based on scientific evidence that resists each other
- having regional, national and international importance in social and political terms
- Considering sustainable development
- Requires understanding of risk and possibility
- The issues that contain cost-benefit analysis in which risks interact with values.

Sadler (2004) states that SSI has two dimensions at the same time: both social and scientific issues. It is possible to explain this with an example like this; considering the nuclear power plants planned to be built in our country, it is observed that basically two different opinions appear as a society. The first one is that supporters considering the aspects of nuclear power plants such as having high energy production and providing employment while the second one is that counterparts considering the radiation it will

emit and the nuclear power plant accidents in the past. As it can be seen, nuclear power plants and their activities, which are a scientific development, have lead up to the emergence of dilemmas, contradictions and controversial opinions socially. For this reason, it is obvious that some scientific developments divide the society, polarize it and create a ground for discussion. From this point of view, we can simply define SSI as controversial social issues which relate to science (Ratcliffe and Grace, 2003; Karpudewan and Roth, 2018; Topçu, Sadler and Yılmaz-Tüzün, 2010; Zeidler, Applebaum and Sadler, 2011).

The development levels of societies in the current century are determined by their scientific studies and research. Society is made up of individuals who are expected to use science and technology effectively, to follow the studies and developments in these areas, and to interpret the effects of these developments on themselves and their surroundings (Çavuş, 2013). On the other hand, science and technology are developing in the same direction in order to adapt to changing society needs (Yolagiden, 2017). Thus, as a result of the interaction between society and science, socioscientific issues with both social and scientific aspects have emerged (Sadler, 2004).

In today's conditions, people may have to choose one of the dilemmas they face with SSIs such as the use of nuclear energy, surrogate motherhood, genetically modified organisms, cloning, nanotechnology, gene therapy, stem cells, global warming or organ donation (Fleming, 1986; Zeidler et al., 2002), which requires scientific knowledge accumulation; they may even need to make decisions or judgments about them.

When the studies in the literature regarding the SSI used in the study are examined; nuclear power plants (Çakıcı and Yılmaz, 2012; Demircioğlu and Uçar, 2014; Özdemir, 2014; Özdemir and Çobanoğlu, 2008; Sürmeli, Duru and Duru, 2017; Yıldırım and Örnek, 2007;); artificial intelligence (Russell and Norvig, 2009; Yabanova, 2016); genetically modified organisms (Akçay, 2017; Costa-Font and Mossialos, 2007; Mercenier, Wiedermann, and Breiteneder, 2001; Richter and Kipp, 1999); surrogate motherhood (Schmidt, 2006; Chen and Ng, 2001; Kılıç et al., 2009); organ transplantation (Sarıtaş, 2005; Yücetin, Keçecioğlu and Ersoy, 2003); cloning (Arslan and Atabey, 2018; Seyalıoğlu et al., 2007); Both scientific and social dimensions of stem cell (Aydın, 2005; Paçacı, 2007; Şahin, Saydam and Omay, 2005) and global warming (Akgün, Balık and Akgün, 2018; Bolat, Kara and Tok, 2018; Nart, 2009) are open to discussion. They need to be examined and investigated within the scope of SSI.

Based on the explanation above, it was aimed to determine the metaphorical perceptions of prospective teachers who will be teachers in the future and teach SSIs to their students about nuclear power plants, artificial intelligence, GMO, surrogate motherhood, organ transplantation, cloning, stem cells, global warming.

1.1. Methaphor

The word metaphor is derived from the Greek word "metapherein" and is used to mean meta, 'change' and pherein 'carry' (Levine, 2005). Metaphor refers to a concept or phenomenon by comparing another concept or phenomenon (Oxford et al., 1998). Similarly, according to Yob (2003), metaphor is a powerful mental tool used by an individual to understand and explain an abstract and complex phenomenon. According to Saban (2005), it is to establish a link between abstract concepts and facts and known concrete concepts. In Shuell (1990), she/he went to an example to explain the metaphor: If a picture is worth 1,000 words, a metaphor is worth 1,000 pictures! For a picture provides only a static image, while a metaphor provides a conceptual framework for thinking about something" (Shuell, 1990: 102).

Lakoff and Johnson (2005) remind that metaphors are conceptual in nature and are used by ordinary people in daily life without any special skills, and they state that metaphors shape thought and language. Metaphors are indispensable for our lives because they are among the factors that determine how to continue our lives to a great extent (Parın, 2017).

In this context, perceptions play an important role by making judgments and decisions regarding SSI. One of the tools used in determining perceptions is metaphors. The elements that shape the thought and language used without requiring great mental activity in order to provide a better understanding of certain concepts are called metaphors (Lakoff and Johnson, 2005). Oxford, Tomlinson, Barcelos, Harrington, Lavine, Saleh and Longhini (1998) stated that it is a metaphor to explain a concept, case or event associating it with another concept.

As a result of the literature review on the subject, it is seen that most of the studies on SSI at higher education level (Al, 2015; Altuntaş, Yılmaz and Turan, 2017; Cebesoy, Karışan and Uysal, 2018; Cebesoy and Şahin, 2013; Çiğdem, 2018; Demiral and Türkmenoğlu, 2018; Gürbüzoğlu Yalmancı and Gözüm, 2016; Hasurrogate motherhoodrman and Çökelez, 2017; İşbilir, 2010; İşeri, 2012; Karakaya, 2015; Keleş Ural, 2018; Kılınç and Sönmez, 2012; Sönmez, 2011; Türkmen, Pekmez and Sağlam, 2017; Türkoğlu and Öztürk, 2019) are directed to prospective teachers in science teaching programs and science fields. In addition, there are studies containing two of the three areas at the same time (Akçay, 2017; Özdemir and Çobanoğlu 2008; Sürmeli, Duru and Duru, 2017; Tekin and Aslan, 2019; Yolagiden, 2017). In the studies reached, there was no research on prospective science, social studies and classroom teachers at the same time. It is very important that there are SSI-related achievements in all three departments in the curriculum, considering the two aspects of SSI as social and scientific,

it is directly related to science, social studies and classroom teaching departments, and there are studies containing three departments about SSI.

1.2. Aim of the study

The aim of this study is to determine the perceptions about socioscientific issues of prospective science, social studies and classroom teachers, who will become teachers in the future and who will teach various SSIs to their students, through metaphor analysis.

In order to achieve this aim, this study sought to answer the following questions:

1. What are the metaphors the prospective teachers have produced for the concepts of nuclear power plants, artificial intelligence, organ transplantation, surrogate motherhood, GMO, stem cell, global warming and cloning from socioscientific issues?
2. What are the conceptual categories of metaphors that prospective teachers have produced for the concepts of nuclear power plants, artificial intelligence, organ transplantation, surrogate motherhood, GMO, stem cell, global warming and cloning?

Method

Qualitative data collection and analysis methods were used in this study. Metaphor can be called a linguistic phenomenon because it has a characteristic of words (Lakoff and Johnson, 2005). For this reason, these metaphors created by the participants were analyzed with content analysis methods designed according to the phenomenology pattern (Patton, 2002; Yıldırım and Şimşek, 2006). In phenomenology design, it is aimed at revealing common practices and defining and explaining the meanings which were created by the participants (Annells, 2006). Creswell (2007) stated that "the basic purpose of phenomenology is to reduce individual experiences with a phenomenon to a description of the universal essence." In phenomenological studies usually aim to reveal and interpret the perceptions or perspectives of individuals on a particular phenomenon (Yıldırım and Şimşek, 2006). In this study, the cases of prospective classroom, science and social studies teachers collected through metaphors were examined.

1.3. Study Group

The sample of the study consisted of prospective science (41), classroom (129), and social studies (73) teachers studying in third and fourth class of the faculty of education at a state university in the Central Black Sea region in Turkey in 2019-2020 academic year. The sample of the study consists of 3rd and 4th class prospective teachers studying in the classroom, science and social studies teaching program, selected according to

convenience sample method. The study group did not take any courses related to SSI during their undergraduate education. In convenience sampling, the researcher determines a sufficient number of items among the available items (Singleton and Straits, 2005). In other words, it is the method by which the researcher turns to the easiest elements she can reach in order to determine her sample from the target universe (Baltacı, 2018).

1.4. Data Collection

Each of the prospective teachers who enrolled into the study was given a form, containing the expression of "The artificial intelligence is like… …… ……because……..." in order to determine prospective teachers' perceptions in the study group on the concept of socioscientific issues .There were eight titles used in the form: Nuclear Power Plants, Artificial Intelligence, Surrogate motherhood, Organ Transplantation, GMO, Global Warming, Stem Cell and Cloning. It was explained to the prospective teachers that they should complete the sentence in the forms given to them, likening the concept of "socioscientific issues" to a unique image, object, or thing basing on their own opinions, and they did not receive any inducement. in the metaphor studies, the expressions of "like/similar to" were used to create a likening, while the expression of "because" was used to base such likening on a rational justification. In this scope, the same way was flowed with similar reasons. The forms filled in by the prospective teachers in their own handwritings were used to collect data as document analyze in the study. There was no time limitation for the teachers to create metaphors for the concept of "socioscientific issues" and the forms filled in by the teachers were collected by the researcher by hand.

1.5. Analysis of Data

The metaphor forms filled in by the prospective teaches in their own handwritings were the main data source of the study as documents. Qualitative data gathered during the research were evaluated through content analysis. Content analysis: It was analyzed by following the steps of data coding, creating categories, organizing codes and categories, validity, reliability, ethical procedures, and identification and interpretation of the findings (Saban, 2006; Strauss and Corbin, 1990; Yıldırım and Şimşek, 2006).

The metaphors produced by the participants were analyzed in five steps. These are: 1) coding and sorting, 2) sample metaphor image compilation, 3) category development, 4) ensuring validity and reliability, and 5) transferring the data to computer environment (Saban, 2008).

The processes carried out at these phases are as follows:

Coding and sorting: In this step, the metaphors produced by the participants under the titles of nuclear power plants, artificial intelligence, organ transplantation, GMO, global warming, surrogate motherhood, stem cell and cloning are arranged in alphabetical order and coded in a simple way. In addition, at this step the forms which was left blank, not written the reason despite of the presentation of the metaphor image and did not contain a logical basis for the metaphor were eliminated.

Sample metaphor image compilation: After eliminating the weak metaphors of the participants, 42 valid metaphors about nuclear power plants, 31 about artificial intelligence, 26 about organ transplantation, 29 about surrogate motherhood, 30 about GMO, 23 about global warming, 28 about stem cells and 21 about cloning were obtained. The metaphors produced in this step were reviewed alphabetically again, and one "a sample of metaphor expression" was determined from the participant views representing each metaphor. In this way, a "sample metaphor list" was created by arranging the metaphor images that best represent each metaphor in order to validate the analysis process and interpretations of the research and to use metaphors as a reference source in the examination of metaphors under certain category titles.

Category development: In this step, the metaphor images produced by the participants were examined in terms of common features in the eight titles studied. Expert opinion is one of the most important factors affecting the validity and reliability of studies (Karasar, 2006). In this framework, it was examined how each metaphor image conceptualizes the nine phenomena studied by considering the sample metaphor lists in line with the views of 2 academicians (Dr.) who are experts in different fields. For this purpose, each metaphor image produced by the participants was analyzed in terms of (1) the subject of the metaphor, (2) the source of the metaphor, (3) the relationship between the subject of the metaphor and its source. After this step, each metaphor image under eight titles was associated with a theme, 2 different categories related to nuclear power, 2 related to artificial intelligence, 4 related to organ transplantation, 2 related to surrogate motherhood, 3 related to GMO, and 2 related to global warming, 3 related to stem cells and 3 related to cloning were created.

Ensuring validity and reliability: In this step, expert evaluation was carried out with the help of 2 Dr. who are experts in the field in the classification of the metaphors produced by the prospective teachers. A 90-minute meeting was held with the experts and they were informed on the category titles and data previously determined. Later, 2 experts grouped the metaphors in the determined categories independently from each other and from the researcher. As a result, the consistence between the classification made by the researcher and that made by the field experts was examined. Miles and Huberman (1994) consider it sufficient to obtain a consistency of 90% and above in the comparison of classifications made by two or more different experts to prove the reliability of the study. In this context, the reliability of the research was calculated using Miles and Huberman's

(1994) formula (Reliability = consensus / consensus + disagreement x 100). As a result of the analysis it was founded that there was at least 93% consistency in nuclear power plants, at least 93% in artificial intelligence, at least 92% in organ transplantation, at least 94% in surrogate motherhood, at least 93% in genetically modified organisms, at least 93% in global warming, at least 92% in stem cells and at least 91% in cloning.

Transferring the data to computer environment: After determining the metaphors and developing conceptual categories with the elemination process, all data were transferred to the SPSS (Statistical Package for the Social Sciences) statistics program, and the number of participants (f) and percentages (%) were calculated.

2. Findings

The total metaphors produced by prospective science, social studies and classroom teachers about nuclear power plants, artificial intelligence, organ transplantation, surrogate motherhood, GMO, global warming, stem cell and cloning through forms of metaphor and the number of categories in which they are evaluated are given in Table 1.

Table 1. Metaphors Produced According to Topics and the Numbers of Categories in Which They Were Evaluated

Topic	Produced Metaphors	Number of Categories
Nuclear Power Plants	42	2
Artificial Intelligence	31	2
Organ Transplantation	26	4
Surrogate Motherhood	29	2
GMO	30	2
Global Warming	23	2
Stem Cell	28	3
Cloning	21	3
Total	230	20

As seen in Table 1. metaphors (42) were at most produced under the title of nuclear power plants, while (21) metaphors were at least produced about cloning. While the metaphors produced about the concept of organ transplantation are examined in four categories, Topics with least (two) categories are nuclear power plants, artificial intelligence, surrogate motherhood, GMO and global warming. Overall, 230 metaphors were produced on the identified social science topics.

42 different metaphors produced by prospective teachers under the title of nuclear power plants were included in 2 categories. Table 2 includes the metaphors produced by prospective teachers according to the category titles.

Table 2. Metaphor Categories Produced by prospective Teachers about Nuclear Power Plants

The Metaphor Categories Produced about Nuclear Power Plants	
Fear and Danger	Benefit
Bomb (16), cancer (14), poison (7), gun (5), garbage (3), fire (2), monster (2), minefield (2), cigarette (2), virus (2), chimney (1), bacteria (1), swamp (1), wolf (1), angel-looking devil (1), germ (1), wind (1), war (1), coffin (1), flood (1), snake (1).	Power (12), sun (8), electricity (5), factory (3), industry (3), family (2), need (2), heart (2), mitochondria (2), mother (1), father (1), bread (1), house (1), medicine (1), lamp (1), fruit-bearing tree (1), miracle (1), teacher (1), money (1), weathervane (1), the stove (1).
Total 66 metaphors, 21 different metaphors	Total 51 metaphors, 21 different metaphors

When Table 2. is examined it is seen that prospective teachers produced 42 different metaphors about "Nuclear Power Plants" and produced metaphors are in two categories, including benefits and fear-threat; prospective teachers' sample sentences in different branches are indicated below;

> Prospective Science Teacher (PST)-1: *"Nuclear power plants are like bombs because bombs explode everything, nuclear power plants explode and destroy".*
>
> Prospective Social Studies Teacher (PSST)-19: *"Nuclear power plants are like minefields because we can disappear at any moment while walking through the minefield, explosion at nuclear power plants at any time."*
>
> Prospective Classroom Teacher (PCT)-34: *"Nuclear power plants are like the sun. Because the sun gives us a lot of energy, it provides a lot of energy in nuclear power plants".*

31 different metaphors produced by prospective teachers on artificial intelligence are included in 2 categories, and table 3 contains metaphors produced by prospective teachers according to the category titles.

Table 3. The Metaphor Categories Produced by Prospective Teachers on Artificial Intelligence

The Metaphor Categories Produced about artificial intelligence	
Superiority	Fear-Negativity
Robot (24), human (5), mind (3), savant (2), miracle (2), space (2), brain (1), science (1), living creature (1), work (1), future (1), medicine (1), internet (1), savior (1), dream (1), peak (1).	Weapon (6), bomb (2), enemy (2), monster (1), medicine (1), nightmare (1), cancer (1), bad child (1), fake friends (1), cyanide (1), terminator (1), virus (1), snake (1).
Total 48 metaphors, 17 different metaphors	Total 20 metaphors, 14 different metaphors

When Table 3. was examined it is seen that prospective teachers produced 31 different metaphors about "Artificial Intelligence" and the metaphors produced are in two

categories as superiority and fear-negativity. The sample sentences of Prospective teachers' in different branches are indicated below.

> PSS-S40: *"Artificial intelligence is like a robot because robots are superior to humans; artificial intelligence also has superiority over human in the same way".*
>
> PSSS-S23: *"Artificial intelligence is like a miracle because miracles are wonderful things that our minds do not understand, extraordinary things that work so well in artificial intelligence."*
>
> PCTS-S98: *"Artificial intelligence is like a weapon because gun harms us, and artificial intelligence harms humanity".*

26 metaphors produced by prospective teachers on organ transplantation were included in 4 categories. Table 4 contains the metaphors produced by prospective teachers according to the category titles.

Table 4. Metaphor Categories Produced by Prospective Teachers on Organ Transplantation

The Metaphor Categories Produced About Organ Transplantation			
Rebirth -Regeneration	Hope	Basic Need	Helpfulness
New Life (20), Seed (9), Newborn Baby (3), Player Change (3), Spring (2), Awakening From Nightmare (1), Spare Life (1), Novelty (1).	Hope (8), Breath (5), Mother (3), Sun (3), Falling In Love (1), Good Teacher (1), Happy Life (1), Summer (1)	Water (7), Air (4), Food (3), Sun (1), Breath (1), Love (1)	Plant (6), Lifeguard (5), Gift (4), Hero (1), Brotherhood
Total 40 metaphors, 8 different metaphors	Total 23 metaphors, 8 different metaphors	Total 17 metaphors, 5 different metaphors	Total 17 metaphors, 5 different metaphors

Table 4. when examined, it is seen that prospective teachers produced 26 different metaphors about "Organ Transplantation" and the metaphors are in 4 categories including rebirth -regeneration, hope, basic need and helpfulness. Prospective teachers' sample sentences in different branches are indicated below:

> PST-9: *"Organ donation is like new life because it's like being reborn after life-giving".*
>
> PSST-16: *"Organ donation is like breath because just as we cannot live without breathing, we cannot live without organ donation".*
>
> PCT -78: *"Organ donation is like a superhero because it tells about helpfulness like a superhero".*

29 different metaphors produced by prospective teachers about surrogate motherhood were included in 2 categories, and in Table 5, the metaphors produced by prospective teachers according to the category titles are shown together with their frequencies and percentages.

Table 5. Metaphor Categories Produced by Prospective Teachers on Surrogate Motherhood

The Metaphor Categories Produced about Surrogate Motherhood	
Possession-Coverage	Inappropriateness
Kangaroo (10), custodian (8), basket (5), bag (4), cargo company (3), bus (3), bee (2), keeper (2), flash memory (2), storage container (2), surprise egg (2), cookery (1), suitcase (1), cabinet (1), factory (1), ant (1), rental house (1), incubator (1), courier (1), market trolley (1), postman (1), bag (1).	Sin (6), Unethical (2), exploitation of emotion (2), rotten fruit (1), child selling (1), cheating (1), stepmother (1).
Total 54 metaphors, 22 different metaphors	Total 14 metaphors, 7 different metaphors

When Table 5. was examined, it is seen that prospective teachers produced 29 different metaphors about "surrogate motherhood " and the metaphors produced are in two categories as possession-coverage and inappropriateness. The sample sentences of prospective teachers in different branches are indicated below.

> PST-21: *"Surrogate motherhood is like a kangaroo because the kangaroo carries her child and the surrogate mother gives life to a child".*
>
> PSST-1: *"Surrogate motherhood is like a custodian because the custodian takes care of someone's belongings for a certain period of time, while surrogate mothers take care of a baby like their own".*
>
> PCT -57: *"Surrogate motherhood is like sinning because you are like the mother of someone else's child, but the child does not know you, I think this is a sin according to religion".*

30 different metaphors produced by prospective teachers about genetically modified organisms are included in 2 categories, and Table 6 contains metaphors produced by prospective teachers according to the category titles.

Table 6. Metaphor Categories Produced by Prospective Teachers on Genetically Modified Organisms

The Metaphor Categories Produced About Genetically Modified Organisms	
Harm-Danger	Necessity
Poison (24), cigarette (7), cancer (6), alcohol (5), rotten fruit (5), virus (4), garbage (2), hormone (2), antibiotic (1), fever (1) , hunter trap (1), swamp (1), weight gain (1), bad friend (1), obesity (1), radiation (1), ultraviolet (1), plague (1),	Vaccination (3), medicine (3), oxygen (3), brain (1), work (1), variety and abundance (1), spinach (1), fruit (1), school (1), marketer (1), telephone (1), commerce (1).
Total 65 metaphors, 18 different metaphors	Total 18 metaphors, 12 different metaphors

When Table 6. is examined, it is seen that prospective teachers produced 30 different metaphors about "GMO" and the metaphors produced are in two categories: harm-danger

and necessity. The sample sentences of prospective teachers in different branches are indicated below.

> PST-11: *"Genetically modified organisms are like poisons because poison kills us, GMO foods kill us too".*
>
> PST-36: *"GMO is like cigarettes because smoking harms our health, and Gmo harms our health like smoking".*
>
> PCT-111: *"GMO is like vaccination because with vaccination, diseased things are destroyed, GMO eliminates diseases in food".*

23 different metaphors produced by prospective teachers on global warming are included in 2 categories, and Table 7 contains metaphors produced by prospective teachers according to the category titles.

Table 7. Metaphor Categories Produced by Prospective Teachers on Global Warming

The Metaphor Categories Produced about Global Warming	
Threat	Precaution
Garbage (5), drought (3), cancer (3), atomic bomb (3), disease (2), virus (2), tree cutting (1), earthquake (1), infection (1) unstitched scarf (1), famine (1), apocalypse (1), mob (1), weapon (1), thirst (1), tumor (1), poison (1).	Education (8), giant wave (3), fire (3), balloon (2), desert (1), fire (1).
Total 29 metaphors, 17 different metaphors	Total 21 metaphors, 6 different metaphors

When Table 7. was examined, it is seen that prospective teachers produced 23 different metaphors about "global warming" and the metaphors produced are in two categories as threat and precaution and inappropriateness. The sample sentences of prospective teachers in different branches are indicated below.

> PST-22: *"Global warming is like garbage. Because if garbage is not eliminated, it will harm our health, if it does not disappear in global warming, it will harm us a lot".*
>
> PSST-71: *"Global warming is like drought. Because drought is water scarcity, it causes water shortage in global warming".*
>
> PCT-97: *"Global warming is like an atomic bomb. Because its effect continues for many years and future generations will also be affected by it".*

28 different metaphors produced by prospective teachers on stem cells are included in 3 categories, and Table 8 contains the metaphors produced by prospective teachers according to the category titles.

Table 8. Metaphor Categories Produced by Prospective Teachers on Stem Cell

Metaphor Categories Produced by Prospective Teacher on Stem Cell		
Hope	Existing-Reborning	Need
Hope (9), tree (6), seed (4), sapling (3), faith (3), family link (1), heart (1), blood (1), bone (1), antidote (1).	Life (12), lifeguard (3), baby (3), rebirth (2), flower (1), birth (1), sweet word (1), pomegranate (1).	Water (4), family (2), hospital (2), bread (1), house foundation (1), sun (1), raw material (1), air (1), spring (1), oxygen (1).
Total 30 metaphors, 10 different metaphors	Total 24 metaphors, 8 different metaphors	Total 15 metaphors, 10 different metaphors

When Table 8. was examined, it is seen that prospective teachers produced 28 different metaphors about "stem cells" and the metaphors produced are in three categories as hope, existing-reborning and need' The sample sentences of prospective teachers in different branches are indicated below

PST-5: *"Stem cells are like hope because we hold on to life thanks to hope, it keeps us alive in the stem cell".*

PSST-39: *"Stem cell is like life because we can find life again from a single cell".*

PCT -71: *"Stem cells are like water because water is our basic need, a basic need in stem cells."*

21 different metaphors produced by prospective teachers about cloning were included in 3 categories, and Table 9 contains metaphors produced by prospective teachers according to the category titles.

Table 9. Metaphor Categories Produced by Prospective Teacher on Cloning

Metaphor Categories Produced by Prospective Teachers on Cloning		
Reproduction	Technology	Threat-Danger
Photocopy (17), copy (11), mirror (8), cell (1), printing press (1), mitosis (1), worm (1), production (1), backup (1).	Factory (2), vaccination (1), science fiction (1), mobile phone (1), teleport (1), robot (1), usb cable (1).	Sin (1), enemy (1), horror movie (1), virus (1), poison (1).
Total 42 metaphor, 9 different metaphors	Total 8 metaphor, 7 different metaphors	Total 5 metaphor, 6 different metaphors

When Table 9. was examined, it is seen that prospective teachers produced 21 different metaphors about "cloning" and the metaphors produced are in three categories as reproduction, technology and threat-danger' the sample sentences of prospective teachers in different branches are indicated below;

PST-13: *"Cloning is like photocopying because we get the same thing with photocopying, and cloning is to get the same creature".*

PSST-29: *"Cloning is like a factory because the latest technology products are together in factories, cloning is the combination of technology".*

PCT -100: *"Cloning is like a sin because what God created is man himself, therefore it is to sin".*

3. Result and Discussion

A total of 230 metaphors were produced and 20 categories were created in this study aiming to determine prospective teachers' metaphorical perceptions on socioscientific issues. When the findings of the study were examined, regarding the 8 different identified socioscientific issues it was observed that their metaphorical perceptions were similar considering the departments of the prospective teachers. Besides, the categories such as benefit (f: 21), fear and danger (f: 21) associated with nuclear power plants; superiority (f: 17), fear and negativity (f: 14) associated with artificial intelligence; rebirth –regeneration (f: 8), hope (f: 8); basic need (f: 5) and helpfulness associated with transplant; possession-coverage (f: 22), inappropriateness (f: 7) associated with surrogate motherhood; harm and danger (f: 18), necessity (f: 12) associated with GMO; threat (f: 17), precaution (f: 6) associated with global warming; hope (f: 10), existing-reborning (f: 8), need (f: 10); associated with stem cell; and reproduction (f: 9), technology (f: 7), threat-danger (f: 6) associated with cloning were formed. In the study, it was seen that prospective teachers of all three departments had both positive and negative perceptions about nuclear power plants, artificial intelligence, surrogate motherhood, GMO, cloning and global warming. This result is directly related to the nature of socioscientific issues because socioscientific issues are the topics that do not have a single correct answer, are open for discussion, and have advantages and disadvantages.

Considering the metaphors produced by prospective teachers on artificial intelligence, organ transplantation and stem cell subjects, it was determined that prospective science, social studies and classroom teachers generally have positive perceptions. Most of prospective teachers have produced metaphors on surrogate motherhood in the category of possession and inclusion, and they generally view the concept of surrogate motherhood positively. Similarly, it was observed that most of the prospective teachers produced metaphors about cloning in the reproduction category and did not have negative perceptions. Türkoğlu and Öztürk (2019) determined in their study that prospective teachers generally took a negative stance on nuclear energy, GMO and sugar loading, and that they generally had positive views towards organ donation. For example, Özdağ (2001) found that age, gender and education have a great impact on societies' awareness and consent for organ donation and transplantation. Akçay (2017) found in his study that prospective teachers did not have positive perceptions about GMO and that these perceptions did not differentiate according to departments. In addition, regarding

genetically modified foods Aksoy (2006) stated that the main issues that consumers want to be informed about are the benefits and risks of genetically modified foods. Bahadır (2017) indicated that prospective teachers do not have enough information about the studies on genetically modified organisms. Bouis, Chassy, and Ochanda (2003), Qin and Brown (2007) emphasized the importance of adequate and accurate information about GMOs. In parallel with our study, Sürmeli, N. Duru, and R. Duru (2017) also found that teachers developed negative attitudes towards nuclear power plants in their studies conducted with classroom and science teachers. Similarly, Ateş and Saraçoğlu (2013), based on their study, stated that prospective science teachers have negative perspectives towards nuclear energy. When the studies are examined, it was seen that prospective teachers' perceptions are positive about organ donation (Akçöltekin, 2014; Akış, et al., 2008; Harman and Çökelez, 2017). In parallel with our study, Ateş and Karatepe (2013) state that in their study, prospective teachers display a negative view on global warming. Similarly, Kaya (2013) found in her/his study that students' perceptions were negative when they examined the metaphors produced by social studies prospective teachers regarding global warming. Similarly, Arslan and Zengin (2016) determined in their study with prospective science teachers that they produced metaphors metaphors containing negativity about global warming.

When the studies are examined, we can say that the results generally are in the same direction with our study. In addition, it has been observed that prospective teachers generally have difficulties in producing metaphors in socioscientific issues and subtitles and in justifying the metaphors they produce. As a reason it can be shown that they do not have sufficient knowledge about the mentioned subjects and they have difficulty in building relationships between concepts.

Prospective teachers from different department have similar negative attitudes on nuclear power plants, GMOs and global warming and it can be explained as having parallel levels of knowledge, the reflection of the general opinion of the society and having similar research aptitude. Likewise, similar positive perceptions have emerged on organ transplantation, stem cell and artificial intelligence according to departments, as the reason for this it can be said that especially the values and lives of the society are open to technological developments and care about human life and the prospective teachers adopt this. When the metaphors about surrogate motherhood and cloning were examined, it was observed that the prospective teachers produced metaphors related to the word meaning of the subjects rather than the social dimensions concerning society. As the reason for this; it can be shown that there is not enough knowledge about surrogate motherhood and cloning, the topics are not discussed sufficiently in daily life due to their social dimensions, and the prospective teachers are not willing enough to research and learn related topics.

The inability to express opinions on socioscientific issues and the difficulty in producing metaphors can be explained by having weakness in knowledge and experience. In this context, the studies should be carried out on the education of these issues from our daily life, and settings and programs can be organized and created to discuss the aforementioned issues. The education of these subjects can be given effectively starting from primary school. In the programs, the acquisitions related to these issues can be discussed, talked in the classroom, in addition suggestions for solution can be offered. Similarly, Wan and Bi (2020) and Çalık, Turan and Coll (2014) emphasized that the inclusion of socio-scientific issues in the curriculum is very important in terms of developing students' basic competencies and effective participation in the decision-making and discussion process. Additionally, Yahaya, Zain and Karpudewan (2015) stated that socioscientific issues have positive effects on prospective teachers' sense of competence.

In addition, the studies on socioscientific issues can be conducted with middle school, high school and university students. Analyses of perception and examinations of attitudes towards the SSI can also be made for the public. In addition, applied debate studies can be conducted about SSIs for university students. Similar large-scale studies can be conducted by including other departments within the scope of the research. The study can be repeated with gender homogeneous groups. SSIs are issues affecting all segments of society and they can be presented to individuals with scientific content on visual and social media, and trainings can be given by experts.

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