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PRE-SERVICE TEACHERS' ATTITUDES AND METAPHORIC PERCEPTIONS TOWARDS RENEWABLE ENERGY RESOURCES

Research article

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Abstract

In the research it was aimed to explore the attitudes and metaphorical perceptions of science, primary school and elementary school mathematics pre-service teachers towards renewable energy resources. The sample of the study consisted of 140 pre-service teachers' studying in the Science Education, Classroom Education and Elementary School Mathematics Education departments of the Faculty of Education of a state university in the 2020-2021 academic year. The attitudes of pre-service teachers towards renewable energy resources were determined by scanning method, which is one of the quantitative research methods. In the research, the Attitude Scale towards Renewable Energy Resources and the metaphor collection form were used as data collection tools. As a result of the research, it was determined that pre-service teachers' attitudes towards renewable energy resources were generally positive and they aimed to educate students who were sensitive to the subject of renewable energy resources. When the 112 metaphors produced by pre-service teachers for renewable energy resources are examined under 3 categories and 10 code titles, it was determined that they expressed the first place is the metaphor of "water", second place is the metaphor of "life", in the third place the metaphors of "child", "oxygen" and "eternity".

Keywords: Pre-service teachers', renewable energy resources, metaphor, attitude

1. Introduction

The energy resources used in the world are divided into two groups as renewable and non-renewable energy resources. Fossil-based energies and nuclear energy are called non-renewable energy resources (Bıyıklı, 2018). Renewable energy resources are energy resources that are always found in the natural environment and can be used repeatedly. (Çelikler et al. 2017; Çolak et al. 2015). Renewable energy resources are solar, wind, wave, hydroelectric, geothermal, biomass, hydrogen and wave energy (Liarakou et al., 2009). Since the industrial revolution, the unconscious and continuous use of non-renewable energy resources such as coal, petroleum and natural gas brings with it the decrease in the reserves of these resources day by day and the occure of the environmental pollution problems (Sarıkaya, 2019). Due to the rapid population growth in the world, the development of technology and the increase in its use, energy needs have increased day by day and energy has become a global problem (Güneş et al. 2013). Because of these problems, new searches have begun in the world for less energy consumption, new energy resources and energy independence (Mutlu, 2016). Renewable energy resources have speciality to eliminate the exhaustible and environmental pollution problems caused by non-renewable energy resources (Sarıkaya, 2019). The education for the correct and effective use of energy resources, which will become an increasing problem, is of great importance (Güneş et al. 2013). Individuals who are aware of renewable energy resources are sensitive to the correct and effective use of energy (Yenice and Tunç, 2018). It is very important to increase the knowledge level of teachers about renewable energy who will educate individuals who are aware of renewable

energy resources and can follow developments in this regard (Mutlu; 2016; Sarıkaya, 2019). The more knowledge and attitudes about renewable energy resources can be developed, the more positive attitudes and behaviors will be given to individuals and efficient use of renewable energy resources will be realized (Genç and Akilli, 2019). Having a positive attitude towards renewable energy resources of teachers, who play an important role in the upbringing of children who will constitute our future, positively affect the attitudes of future generations on this issue (Yüzbaşıoğlu et al., 2019). Seeing education as an important factor for students to use renewable energy resources correctly and effectively and gain energy saving habits is related to the reflection of teacher candidates' thoughts Guven and Cakir, (2019).

Many studies in the literature that examine attitudes towards renewable energy resources (Balbağ and Balbağ, 2019; Bilen et al., 2013; Bozdoğan and Yiğit, 2014; Cebesoy and Karışan, 2017; Çelikler and Kara, 2011; Emlik, 2017; Fırat et al. 2012; Genç, 2019; Guven and Cakir, 2019; Karasmanaki and Tsantopoulos, 2019; Karatepe et al., 2012; Mutlu, 2016; Tiftikçi, 2014; Yenice and Alpak Tunç, 2018; Yüzbaşıoğlu et al., 2019; Zyadin et al., 2012; Zyadin et al., 2014). From these studies; Çelikler and Kara (2011) found that pre-service social studies teachers were more aware of renewable energy than elementary school mathematics pre-service teachers', but there was no significant difference in the comparison by gender; Bilen et al. (2013) found that science pre-service teachers had a positive attitude towards renewable energy resources as a result of their study; Emlik (2017) examined pre-service teachers' attitudes towards renewable energy resources, efficient use of energy and technological pollution awareness according to the variables of gender, department, class, general academic achievement scores, parents' education level and family income and did not find a significant difference according to these variables. Liarakou et al. (2009), as a result of their studies examining the knowledge and attitudes of secondary school teachers in Greece towards renewable energy sources, especially wind and solar energy systems, found that although teachers have a positive attitude and knowledge about renewable energy sources, they do not express clear opinions on wind and solar energy technologies. they have done. Zyadin et al. (2012), explored students' knowledge, awareness, and attitudes towards renewable energy resources in a country that is heavily dependent on fossil fuels despite having a large amount of renewable energy resources. As a result of the research, they found that students have limited ability to distinguish renewable energy sources from non-renewable energy sources. Zyadin et al. (2014), as a result of their study of middle school teachers' knowledge and attitudes about renewable energy sources, found that teachers have limited knowledge about renewable energy. Keramitsoglou (2016) stated that as a result of his study, which investigated the knowledge and attitudes of high school students about renewable energy sources, the curriculum should be developed against the students' indifference, neutrality and confusion about energy issues and renewable energy resources technologies, equality, flexibility, participatory approach and creativity. Ntanos et al. (2016), as a result of their studies examining the perceptions of postgraduate, undergraduate students and personnel in the area of university towards renewable energy sources, they found a positive attitude towards renewable energy sources, especially in solar energy.

Metaphor is to express by using a word or concept in a way that means other than its known and accepted meaning (Anılan, 2017). Metaphors are easier and more practical data collection tools than individual or focus group meetings, observation or document review (Ergün and Kıyıcı, 2019). Metaphors are enable the unknown things to be learned, the things learned to be kept in mind and remembered when necessary (Afacan, 2011).

Examining some of the researches on the subject: Kurt (2019) in his research; as a result of examining the metaphors developed by pre-service teachers' of physics about

electricity, he determined that metaphors are successful in concretizing abstract concepts, but in some cases they appear as learning difficulties. Lancor (2012) stated that in order to understand the studies on energy more clearly, it is necessary to know the metaphors first (cited in Kurt, 2019). Kuzu et al. (2018) in his research investigating the attitudes and metaphorical perceptions of the lamb pre-service teachers towards the concept of mathematics, the positive metaphors of pre-service teachers with positive attitudes; They found that pre-service teachers with negative attitudes have negative metaphors. Çil (2018) in his study examining the metaphorical perceptions of middle school students towards the concept of energy; he stated that the students produced firstly in the place "Metaphors Related to Life (football, food, water, living, sports, technology)" category; secondly in the place "Metaphors Established with Different Science Terms (business, electricity, motion, technology)" category; thirdly in the place (sun, weather vane, water, food, battery)" category and at least in the place "Misconception Metaphors (work, movement)" category. In the research, it was provided to determine how pre-service teachers' named the concept of renewable energy resources and the reasons for this naming through metaphors in the study. Being sensitive on renewable energy resources for pre-service teachers' who will educate future generations will also make students aware of this issue. The importance of this study stems from the need to better understand the role of pre-service teacher education who will raise future generations in order to raise awareness of renewable energy sources, which are necessary for today's students to be responsible energy consumers in the future. According to Cebesoy and Karışan, (2017) the most important responsibility for raising awareness of renewable energy in future generations belongs to the science courses that include these subjects and the science teachers who are the instructors of these courses. Therefore, the increase in teachers' awareness of these resources will be reflected in their classroom teaching practices.

Problem of Research

The aim of current study is to determine the attitudes and metaphorical perceptions towards renewable energy resources of science, classroom and elementary school mathematics pre-service teachers'. For this purpose, answers to the following questions were sought:

In the quantitative part of the research;

- How are the general attitudes of science, classroom and elementary school mathematics pre-service teachers towards renewable energy resources?
- How does science, classroom and elementary school mathematics pre-service teachers' attitudes towards renewable energy resources differ according to their gender?
- How does science, classroom and elementary school mathematics pre-service teachers' attitudes towards renewable energy resources differ according to their departments?

In the qualitative part of the research;

- What are the metaphors that science, primary school and elementary school mathematics pre-service teachers' have created for the concept of renewable energy resources?
- Under which categories can metaphorical perceptions of science, classroom and elementary school mathematics pre-service teachers be collected about the concept of renewable energy resources?

2. Research Methodology

In the study, a mixed research method, in which quantitative and qualitative research methods were used together, was used to investigate the attitudes and metaphorical perceptions of science, classroom and elementary school mathematics pre-service teachers' towards renewable energy resources. In this study, the metaphorical perceptions of the pre-service teachers' participating were determined by one of the qualitative research methods, the phenomenological design, and the attitudes of the pre-service teachers' towards renewable energy resources were determined by one of the quantitative research methods, the scanning method. A phenomenological study describes the meaning for several individuals of their lived experiences of a concept or a phenomenon (Creswell, 2013).

2.1. Participants

The sample of the research consisted of 140 pre-service teachers' studying in the Science Education, Classroom Education and Elementary School Mathematics Education departments of the Faculty of Education of a state university in the 2020-2021 academic year. While determining the sample, the method of determining the sample was not used, and it was aimed to reach the whole study group studying in the last year of science, classroom and elementary mathematics teaching at a state university. However, since some participants did not want to participate in the study or did not fill in the metaphor form (N=172) 81% of the whole study group was reached as a result of the research.

Table 1 presents the distribution of pre-service teachers according to their gender and their department.

Table 1. Distribution of pre-service teachers' according to the education departments and genders

Participants		***f***	***%***
Gender	Female	92	65.7
	Male	48	34.3
Department	Science Education	53	37.9
	Classroom Education	43	30.7
	Elementary School Mathematics Education	44	31.4
Total		140	100

Table 1 shows that the demographic characteristics of the research study group. The study group consisted of undergraduate students studying in Science Education, Classroom Education and Elementary School Mathematics Education departments. 92 (65.7%) of the 140 pre-service teachers' participating in the study are female and 48 (34.3%) are male. Of the pre-service teachers', 53 (37.9%) were teaching Science Education, 43 (30.7%) Classroom Education, and 44 (31.4%) Elementary School Mathematics Education.

2.2. Instruments

In the research, the attitudes of pre-service teachers' towards renewable energy resources were determined with the "Attitude Scale Towards Renewable Energy Resources" developed by Güneş et al. (2013). The scale consists of 26 items and four sub-dimensions: "application request", "importance of education", "country interest" and "environmental awareness and investments". In the 5-point Likert-type scale, it can be answered as "Absolutely Disagree", "Disagree", "Undecided", "Agree" and "Totally Agree". The reliability of the scale was .87 and the reliability of its sub-dimensions is .97, .80, .78 and .72, respectively. The reliability of the scale of attitude towards renewable energy resources used in this study was found 0.94 and the reliability of its sub-dimensions is .78, .74, .83 and .82 respectively.

Participants can get a minimum of 26 and a maximum of 130 points on the scale. The values of a total of 16 items with negative meanings in the scale were converted to 5-1, 4-2, 3-3, 2-4, 1-5 points while calculating. The high scores from the scale are considered to be high in the attitudes of the pre-service teachers' towards renewable energy resources.

In the study, the metaphorical perceptions of pre-service teachers' about renewable energy resources were collected through the metaphor collection form. The meaning that pre-service teachers' attributed to the concept of renewable energy resources was tried to be revealed through metaphors. For this purpose, they were asked to fill in the sentence "renewable energy resources are similar to ... because ...".

2.3. Data Analysis

Descriptive analysis method and one-way ANOVA data analysis methods were used to analyse the quantitative data of the research; and qualitative data were analyzed using content analysis method. Independent sample t-test was used to determine whether pre-service teachers'' attitudes towards renewable energy resources differ according to gender variable by evaluating the data obtained from the research; One-way analysis of variance (ANOVA) was conducted to determine whether it differs according to the department. After performing the ANOVA test, the Scheffe test was used as a complementary post-hoc analysis to determine the differences.

In analyzing the data obtained from the metaphor form in the research; the metaphors produced meaningless were eliminated. What was written in metaphor form constituted the main data source of the research and unhealthy data were eliminated. The framework of the study is as follows: determination of metaphors according to the content analysis method, classification of metaphors, category development, validation and reliability stages, analysis and exemplification of the metaphors produced by the participants (Kuzu et al. (2018). The metaphors obtained from the study are listed alphabetically and the conceptual categories representing for each metaphor, the metaphors and codes under each category, and the frequency and percentage values of these metaphors are calculated and shown in the tables.

In the research, before the correlation analysis, it was checked whether the data showed a normal distribution. For the normality test, Kurtosis and Skewness values were examined. In the "Application Request" sub-dimension, the Kurtosis value is +.844 and the Skewness value is -1.278; In the "Importance of Education" sub-dimension, the Kurtosis value is +1.235 and the Skewness value is -.544; In the "Country Interest" sub-dimension, the Kurtosis value is +.954 and the Skewness value is -1.530; In the "Environmental Awareness

and Investments" sub-dimension, the Kurtosis value was +.966 and the Skewness value was -.866, and the Kurtosis value was +1.23 and the Skewness value -1.509 in the overall scale. According to Tabachnick and Fidell (2007), the values of Kurtosis and Skewness between -1.5 and +1.5 indicate the normal distribution of the data. The correlation analysis was performed with SPSS 20 program in the significance level of .05.

2.4. Research Ethics

Ethical principles and rules were followed during the planning, data collection, analysis, and reporting of the research. Ethical compliance approval was obtained for this research in accordance with the decision of Artvin Çoruh University Ethics Committee dated 26.10.2020 and numbered 13.

3. Results and Data Interpretation

Table 2. Examining the attitude scores of pre-service teachers' according to all of the scale and sub-dimensions

	N	***Mean***	***S.D***	***Min.***	***Max.***
Application Request	140	4.064	0.598	1.000	5.000
Importance of education	140	4.226	0.571	1.000	5.000
Country interest	140	4.233	0.746	1.330	5.000
Environmental awareness and investments	140	4.114	0.595	1.670	5.000
General Attitude Scale Towards Renewable Energy Resources	140	4.158	0.525	1.770	5.000

Table 2 shows that the average of science, classroom and elementary school mathematics pre-service teachers' attitudes towards renewable energy resources in general and sub-dimensions. Accordingly, it was determined that the average of all and sub-dimensions of the scale was high. The average of the "Application Request" sub-dimension is high 4.064 ± 0.598 (Min=1; Max=5), the average of the "Importance of Education" sub-dimension is very high 4.226 ± 0.571 (Min=1; Max=5), the average of the "Country Interest" sub-dimension very high 4.233 ± 0.746 (Min=1.33; Max=5), the average of the "Environmental Awareness and Investments" sub-dimension high 4.114 ± 0.595 (Min=1.67; Max=5), and the "General Attitude towards Renewable Energy Resources" average of 4.158±0.525 (Min = 1.77; Max=5).

Table 3. One-way variance analysis results of pre-service teachers' attitude scores according to the department

	Group	*N*	*Mean*	*S.D*	*F*	*p*	*Difference*
Application Request	Science Education	53	4.334	0.429	10.173	**.001**	**1>2 1>3**
	Classroom Education	43	3.950	0.558			
	Elementary School Mathematics Education	44	3.851	0.693			
Importance of education	Science Education	53	4.404	0.403	4.698	**.011**	**1>2 1>3**
	Classroom Education	43	4.163	0.647			
	Elementary School Mathematics Education	44	4.071	0.617			
Country interest	Science Education	53	4.374	0.608	1.768	.175	
	Classroom Education	43	4.093	0.916			
	Elementary School Mathematics Education	44	4.201	0.698			
Environmental awareness and investments	Science Education	53	4.293	0.485	4.104	**.019**	**1>2 1>3**
	Classroom Education	43	4.035	0.732			
	Elementary School Mathematics Education	44	3.977	0.520			
General Attitude Scale Towards Renewable Energy Resources	Science Education	53	4.353	0.378	6.367	**.002**	**1>2 1>3**
	Classroom Education	43	4.060	0.613			
	Elementary School Mathematics Education	44	4.020	0.526			

Table 3 shows that the results of one-way analysis of variance to determine the differentiation of attitude scores of science, classroom and elementary school mathematics

pre-service teachers' attitude towards renewable energy resources according to the department variable. The attitude scores of the pre-service teacher towards renewable energy resources according to their departments show a significant difference in the "application request" sub-dimension ($F_{(2,137)}$=10.173; p<.05). The reason for the difference; In the "application request" sub-dimension, the mean scores of science pre-service teachers' ($\bar{x}$=4.334) are statistically significantly higher than the scores of classroom pre-service teachers' ($\bar{x}$=3.950) and the scores of elementary school mathematics pre-service teachers' ($\bar{x}$=3.851).

There is a significant difference in the attitude scores towards renewable energy resources according to the departments of science, classroom and elementary school mathematics pre-service teachers' in the "Importance of Education" sub-dimension ($F_{(2,137)}$=4.698; p<.05). The reason of the difference is that in the "Importance of Education" sub-dimension, the mean scores of science pre-service teachers ($\bar{x}$=4.404) are statistically significantly higher than the scores of classroom pre-service teachers' ($\bar{x}$=4.163) and the scores of elementary school mathematics pre-service teachers' ($\bar{x}$=4.071).

There is a significant difference in the attitude scores towards renewable energy resources according to the departments of science, classroom and elementary school mathematics pre-service teachers' in the "Environmental Awareness and Investments" sub-dimension ($F_{(2,137)}$= 4.293; p<.05). The reason of the difference is that in the "Environmental Awareness and Investments" sub-dimension, the mean scores of science pre-service teachers' ($\bar{x}$=4.293) are statistically significantly higher than the scores of classroom pre-service teachers' ($\bar{x}$=4.035) and the scores of elementary school mathematics pre-service teachers' ($\bar{x}$=3.977).

Attitude scores towards renewable energy resources according to the departments of science, classroom and elementary school mathematics pre-service teachers' show a significant difference in overall scores in the whole scale ($F_{(2,137)}$=6.367; p<.05). The reason of the difference is that the general scores of attitude towards renewable energy resources of science pre-service teachers' ($\bar{x}$=4.353) are statistically significantly higher than both the general scores of attitude towards renewable energy resources of the classroom pre-service teachers' ($\bar{x}$=4.060) and the general scores of attitude towards renewable energy resources of the elementary school mathematics pre-service teachers' ($\bar{x}$=4.020).

The difference in the attitude scores of science, classroom and elementary school mathematics pre-service teachers towards renewable energy resources according to the department in the "Country Interest" sub-dimension is not statistically significant (p>.05).

Table 4. Independent groups t-test results of attitude scores of pre-service teachers' according to gender

	Group	*N*	*Mean*	*S.D*	*t*	*df*	*p*
Application Request	Female	92	4.104	0.489	1.089	138	.344
	Male	48	3.988	0.766			
Importance of Education	Female	92	4.298	0.387	2.109	138	.089
	Male	48	4.086	0.802			
Country interest	Female	92	4.268	0.670	0.763	138	.447
	Male	48	4.167	0.877			
Environmental Awareness and Investments	Female	92	4.165	0.499	1.398	138	.219
	Male	48	4.017	0.742			
General Attitude Scale Towards Renewable Energy Resources	Female	92	4.208	0.393	1.567	138	.191
	Male	48	4.063	0.709			

Table 4 shows that independent groups t-test analysis results are seen in order to determine the differentiation of attitude scores of science, classroom and elementary school mathematics pre-service teachers' attitude towards renewable energy resources according to gender variable. Accordingly, no statistically significant difference was found in terms of "application request", "importance of education", "country interest", "environmental awareness and investments" and "General attitude towards renewable energy resources" scores according to gender variable ($p>.05$).

The metaphors developed by science, classroom and elementary school mathematics pre-service teachers' participating in the study, for the concept of renewable energy resources were categorized in consideration of their characteristics. Relatedly; the conceptual categories, metaphors and codes under each category and the frequency and percentage values of these metaphors are given in the tables below.

Table 5. Frequency and percentage distributions of metaphor created towards renewable energy resources

Metaphor No	Metaphor name	f	%	Metaphor No	Metaphor name	f	%
	Tree	3	2.68	**30.**	Paper	1	0.89
	Stream	1	0.89	**31.**	Heart	2	1.79
	Mind	1	0.89	**32.**	Vicious circle	2	1.79
	Gold	4	3.57	**33.**	Book	1	0.89
	Mother	1	0.89	**34.**	Moneybox	1	0.89
	Car	1	0.89	**35.**	River	1	0.89
	Baby	2	1.79	**36.**	Oxygen	5	4.46
	A white sheet	1	0.89	**37.**	Organic product	1	0.89
	Knowledge	1	0.89	**38.**	Forest	1	0.89
.	Plant	2	1.79	**39.**	Money	3	2.68
.	Flower	2	1.79	**40.**	PI number	1	0.89
.	Child	5	4.46	**41.**	Battery	2	1.79
.	Child education	2	1.79	**42.**	Fortune	1	0.89
.	Blood in the vein	1	0.89	**43.**	Love	4	3.57
.	Book	1	0.89	**44.**	An endless resource	1	0.89
.	Sea	1	0.89	**45.**	Infinity	5	4.46
.	Nature	1	0.89	**46.**	Water	10	8.93
.	Nature friendly	1	0.89	**47.**	Water cycle	2	1.79
.	Ferris wheel	1	0.89	**48.**	Basic need	1	0.89
.	Transformation	1	0.89	**49.**	Technology	1	0.89
.	World	1	0.89	**50.**	Clean environment	1	0.89
.	Diamond	1	0.89	**51.**	Clean Air	1	0.89
.	Universe	1	0.89	**52.**	Seed	1	0.89
.	Night and day	1	0.89	**53.**	Soil	1	0.89
.	Recycling	1	0.89	**54.**	Pen	1	0.89
.	Sun	3	2.68	**55.**	Inexhaustibility	1	0.89
.	Life	9	8.04	**56.**	Life	3	2.68
.	Medicine	1	0.89	**57.**	Gravity	1	0.89
.	Human	3	2.68	**58.**	Time	2	1.79
					Total	112	100

According to the findings in Table 5 the metaphors developed by all science, classroom and elementary school mathematics pre-service teachers' regarding the concept of renewable energy resources are given alphabetically. The pre-service teachers participating in the study

produced 58 metaphors in total. Although 140 pre-service teachers participated in the study, some pre-service teachers did not produce metaphors, produced meaningless metaphors or left blank, and metaphors developed by a total of 112 pre-service teachers were evaluated within the scope of the study.

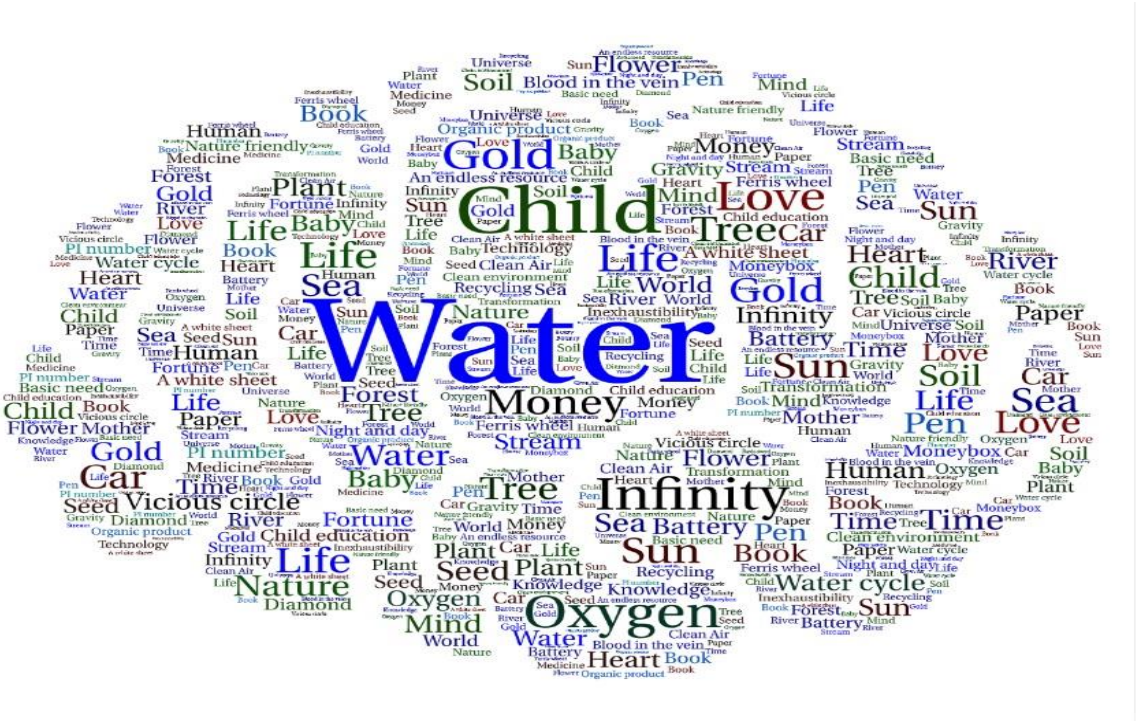

Figure 1. *Word cloud of metaphors for all categories*

Figure 1 shows the word cloud of the metaphors for all the categories that the pre-service teachers' developed for the concept of renewable energy resources. It is seen that the pre-service teachers' explain the concept of renewable energy resources mostly with the metaphor of "water" (f=10, 8.93%), and followed by, in the second place, the "life" metaphor (f=9, 8.04%); third place (f=5, 4.46%) with the metaphors of "child", "oxygen" and "eternity"; fourth place (f=4, 3.57%) with "gold" and "love" metaphors; fifth place (f=3, 2.68%) with the metaphors of "tree", "sun", "money" and "life"; sixth place (f=2, 1.79%) with "baby", "plant", "flower", "human", "heart", "vicious circle", "battery", "water cycle" and "time" metaphors. The remaining 37 metaphors were determined as (f=1, 0.95%)

Table 6. Metaphors of pre-service teachers on the concept of renewable energy resources

Category	Code	Metaphor	Metaphor number	f	∑f	%
Inexhaustible Resource	Inexhaustibility	Knowledge, battery(2), wealth, pen, Inexhaustibility	5	6	31	27.68
	Endless	The sea, the universe, Pi number, an endless resource, infinity(5)	5	9		
	Cyclical	Transformation, recycling, vicious circle(2), water cycle(2), nature, Ferris wheel, paper	7	9		
	Continuity	Stream, day and night, sun (3), blood in vein, river	5	7		
Necessary for Life	Vital	Mother, lifelong(9), heart(2), oxygen(5), life(3), gravity	6	21	41	36.61
	Beneficial	Clean environment, clean air, nature friendly, organic product, forest, love(4)	6	9		
	Need	Water(10), basic need	2	11		
As a Value	Appreciate	Tree(3), world, diamond, book	4	6	40	35.71
	Interest relevance	Baby(2), plant(2), flower(2), child(5), human(3)	5	14		
	Proper use	Gold(4), mind, car, white sheet, education of children(2), notebook, medicine, Moneybox, money(3), technology, seed, soil, time(2)	13	20		
		Total	58	112	112	100

Table 6 shows that 58 metaphors developed by pre-service teachers for the concept of renewable energy resources were classified into 3 categories and 10 codes. According to their characteristics; the codes of “inexhaustibility”, “endless”, “cyclical” and “continuity” under the category of “inexhaustible source”, the codes of “vital”, “beneficial” and “needs” under the category of “necessary for life”, the codes of “appreciate”, “interest-relevance” and “proper use” under the category of “as a value” were created. According to the frequency values, the categories created by analyzing the metaphors developed by the pre-service teachers’; The category “necessary for life” is the highest frequency (f=41, 36.61%), in the

second place is the category “as value” (f=40, 35.71%), in third place is the category “inexhaustible resource” (f=31, 27.68%).

31 pre-service teachers developed 22 different metaphors for the formation of the "Inexhaustible Resource" category. These metaphors are stream, knowledge, blood in the vein, nature, ferris wheel, transformation, day and night, recycling, sun, paper, vicious circle, river, battery, wealth, water cycle, inexhaustibility, pen metaphors. Some of the answers from the pre-service teachers’ who are the source of this category are given below.

- *“Renewable energy resources are like the sun, because when our energy resources are low, we can regain energy with renewable energy resources”.*
- *“Renewable energy resources are like blood in the vein, because the continuity of the energy source is ensures”.*
- *“Renewable energy resources are similar to paper because they can be reused if recycled like paper”.*
- *“Renewable energy resources are like nature because; they repeat themselves in a regular way”.*
- *“Renewable energy resources are like a Ferris wheel, they constantly renew themselves”.*
- *“Renewable energy resources are like the water cycle, because it ensures the continuity of life, cleans itself and renews and nourishes the nature”.*

41 pre-service teachers’ developed 14 different metaphors in the formation of the “Necessary for Life” category. These metaphors are mother, nature friendly, life, heart, oxygen, organic product, forest, love, water, basic need, clean environment, clean air, life and gravity metaphors. Some of the answers from the pre-service teachers’ who are the source of this category are given below.

- *“Renewable energy resources are like oxygen, because it is just as vital”.*
- *“Renewable energy resources are like water, because water is the to survive and energy is to stay in the world. Clean energy is a clean world”.*
- *“Renewable energy resources are like clean air, because the more natural it is the more energy saving”.*
- *“Renewable energy resources are like basic needs, nothing can continue”.*
- *“Renewable energy resources are environmentally friendly, because they do not harm the nature”.*
- *“Renewable energy resources are like love, because they do not harm”.*
- *“Renewable energy resources are like forests, because we become very sad when they disappear like forests”.*
- *“Renewable energy resources are like life, because life would be difficult without renewable energy resources”.*
- *“Renewable energy resources are like our hearts, because they are our source of life”.*

40 pre-service teachers’ developed 22 different metaphors in the formation of the “As a Value” category. These metaphors are tree, mind, gold, car, baby, a white page, plant, flower, child, child education, notebook, world, diamond, medicine, human, book, moneybox, money, technology, seed, soil and time metaphors. Some of the answers from the pre-service teachers’ who are the source of this category are given below.

- *“Renewable energy resources are like trees, because the more we develop the root like a tree, the more beautiful and delicious its fruit will be”.*

- *"Renewable energy resources are like children, because if you look after very well, children will grow and develop well".*
- *"Renewable energy resources are like babies, because we can look after babies regularly stage by stage. Likewise, if we can use renewable energy resources correctly, we can get the efficiency what we want and help keep nature cleaner".*
- *"Renewable energy resources are similar to plants, because the more proper care and attention we do, the more energy we will get".*
- *"Renewable energy resources are like medicine, because they can save lives if used correctly, and misuse can cause many negative results".*
- *"Renewable energy resources are like diamonds, because they are valuable".*
- *"Renewable energy resources are like money, because if we use renewable energy resources carefully, like our money, we can live in a better world.".*
- *"Renewable energy resources are like technology, because they will fully benefit when used correctly".*
- *"Renewable energy resources are like books, because the more you read, the better you realize their value".*
- *"Renewable energy resources are like time, because it can renew itself as time renews itself every day, but the main point is how we use it".*

4. Discussion

In the research, it was aimed to investigate the attitudes and metaphorical perceptions of science, classroom and elementary school mathematics pre-service teachers' towards renewable energy resources. The results of the study showed that the attitudes of science, classroom and elementary school mathematics pre-service teachers' towards renewable energy resources were generally positive in all and sub-dimensions of the scale. This result of the study is similar to results of some previous studies (Bıyıklı, 2018; Bilen et al. 2013; Bozdoğan and Yiğit, 2014; Cebesoy and Karışan, 2017; Çelikler and Kara, 2011; Fırat et al. 2012; Kaldellis et al. 2012; Karasmanaki and Tsantopoulos, 2019; Liarakou et al., 2009; Ntanos et al. 2016; Yenice and Alpak Tunç, 2018; Yüzbaşıoğlu et al., 2019), but not smilar to some other results of some studies (Karatepe et al. 2012; Yenice and Alpak Tunç, 2018) stated that pre-service science teachers' attitudes towards renewable energy resources are at a positive level because they have a pro-environmental approach to solve energy problems, which is a global problem.

In the research, no significant difference was found between the science, classroom and elementary school mathematics pre-service teachers' attitude scores towards renewable energy resources according to the gender variable. This result is consistent with the results of previous studies (Bilen et al. 2013; Çelikler and Kara, 2011; Emlik, 2017; Genç, 2019; Mutlu, 2016; Tiftikçi, 2014) Balbağ and Balbağ (2019) found that pre-service teachers' of science and classroom attitudes towards renewable energy resources were in favor of female pre-service teachers' in total scores and only in the "application request" sub-dimension. Fırat et al. (2012) found that the attitudes of teachers candidates who study in pre-school teaching, classroom teaching and teaching geography departments towards renewable energy according to their gender were in favor of male participants. Zyadin et al. (2014) found that male teachers' awareness of renewable energy is more positive than female teachers. However, Karatepe et al. (2012) found that female students' attitudes towards renewable energy resources were significantly higher than male students.

In the study, according to the department variable, the attitude general scores of science pre-service teachers towards renewable energy resources were statistically significantly

higher than the general scores of the classroom and elementary school mathematics pre-service teachers. According to this result, it is seen that science pre-service teachers' have more positive opinions about renewable energy resources. The reason for this can be shown that the number of courses taken by science pre-service teachers' about renewable energy resources during their undergraduate education is higher than of elementary school mathematics and classroom pre-service teachers'. Tiftikçi (2014) found that the awareness of science pre-service teachers' about renewable energy resources was significantly higher than physics, chemistry and biology pre-service teachers'. Balbağ and Balbağ (2019) did not find any difference in the attitudes of elementary and science pre-service teachers towards renewable energy resources in general and sub-dimensions of the scale. Fırat et al. (2012) found that pre-school teaching attitudes towards renewable energy have a lower attitude than classroom teaching and teaching geography. Mutlu (2016) did not detect a significant difference according to the department variable in the general awareness levels towards renewable energy resources of the pre-service teachers' studying in physics, chemistry and biology departments. Emlik (2017) found that pre-service science teachers and pre-service classroom teachers'' attitudes towards renewable energy resources do not differ according to their departments.

As a result of the evaluation of the attitude scores of pre-service teachers towards renewable energy resources in the sub-dimensions of "Application Request", "Importance of Education", "Environmental Awareness and Investments" in the study according to the department variable; The mean scores of science pre-service teachers' were found to be statistically significantly higher than the mean scores of the classroom and elementary school mathematics pre-service teachers'. According to the departments, the difference in the "Country Interest" sub-dimension in the attitude towards renewable energy resources scores of science, classroom and elementary school mathematics pre-service teachers' is not statistically significant.

The pre-service teachers' developed metaphors for the concept of renewable energy resources and among these methaphors under the category of "Inexhaustible Resources (f=31, 27.68%)", the codes of "Inexhaustibility", "Infinite", "Cyclic" and "Continuity", under the category of "Necessary for Life (f=41, 36.61%)", "Vital", "Useful" and "Need" codes; under the category of "As Value (f=40, 35.71%)", "Knowing the Value", "Interest-Relevance" and "Correct Use" codes were created. The pre-service teachers' expressed the concept of renewable energy resources in the first place with the metaphor of "Water", in the second place with metaphor of "Life", in the third place with the metaphors of "Child", "Oxygen", "Eternity".

5. Conclusions

It is extremely important that pre-service teachers, who will raise future generations, develop a positive attitude about renewable energy resources in order to increase knowledge, attitude and awareness on this subject due to the increasing need for energy and the rapid consumption of energy resources with the changing world. In this context, the attitudes of all pre-service teachers on renewable energy resources should be determined without making any discrimination, and trainings in this direction should be given before graduation in order to increase their knowledge, attitude and awareness on the subject. In addition, it is recommended to investigate the factors affecting pre-service teachers' attitudes towards renewable energy resources. In addition, the knowledge levels of pre-service teachers on renewable energy resources can be investigated, and the relationship between their knowledge and metaphor can be examined.

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