Analysis of Pre-service Science and Classroom Teachers' Attitudes and Opinions Concerning Renewable Energy Sources in Terms of Various Variables

Mustafa Doğru*, Melahat Çelik**‡

* Akdeniz University, Faculty of Education, Department of Mathematics and Science Education, Dumlupınar Road, Campus, Konyaaltı, Antalya, Turkey

** Akdeniz University, Faculty of Education, Department of Mathematics and Science Education, Dumlupınar Road, Campus, Konyaaltı, Antalya, Turkey

(mustafadogru@akdeniz.edu.tr, melahat.celik.514@gmail.com)

‡ Corresponding Author: Mustafa Dogru, Faculty of Education, Akdeniz University, Dumlupınar Road, Campus, Konyaaltı, Antalya, Turkey Tel: +90 242 310 2103

Received: 22.10.2019 Accepted:02.12.2019

Abstract- In today's societies, energy needs increase endless in time. The importance of renewable energy sources comes to the fore every day due to the inability of the non-renewable and non-eco-friendly energy sources, such as coal, oil and natural gas, which are frequently used to meet this need, as well as the environmental problems they cause. The need for teachers who are aware of the importance of renewable, eco-friendly energy sources and new generations to be trained by these teachers is increasing day by day. The aim of this research is to reveal the factors that affect the attitudes of pre-service science and classroom teachers towards renewable energy sources and their opinions about renewable energy sources. For this purpose, the "Convergent Parallel Method (Quantitative + Qualitative)", one of the mixed methods, was selected for this study. The sample of the study consisted of a total 373 pre-service teachers, 192 (161 Girls, 31 Boys) pre-service science teachers from the first to fourth grades, and 181 pre-service classroom teachers (128 girls, 53 boys) from the first to fourth grades. According to the results obtained from the quantitative data of the research; gender, grade and family income variables did not create a significant difference in the attitudes of pre-service science teachers towards renewable energy sources. Regarding the pre-service classroom teachers, grade, family income and department variables did not create a significant difference in their attitudes towards renewable energy sources, whereas gender made a significant difference. Qualitative findings of the study revealed that both pre-service Science and Classroom Teachers do not have enough knowledge about renewable energy sources.

Keywords Pre-service Science Teachers, Pre-service Classroom Teachers, Attitude, Renewable Energy Sources

1. Introduction

Today, where energy needs are at the highest level, the increase in the population, along with the development of technology and industry, has brought the increasing problem of energy requirements [1], [2]. In developing countries such as Turkey and in some developed countries, emerging energy needs are still largely met by fossil fuels such as natural gas, oil and coal, and hydraulic and nuclear power plants. In particular, fossil fuels and radioactive elements used in nuclear energy are seriously damaging the environment and global reserves are decreasing day by day. The fact that these energy sources will not be able to meet the increasing energy needs over the long term and the environmental problems they create has resulted in an orientation towards more eco-friendly and sustainable energy sources all over the world. In particular, while creating energy policies, countries in the world aimed both to obtain the energy needs in the best way and to use the energy types that will minimize the environmental problems without damaging the environment.

[3]. Nevertheless, ever-increasing consumption of fossil fuels damages the natural environment, causing the ecological balance to deteriorate and consequently increasing environmental problems very quickly [4].

Today, serious investments are being made in renewable energy sources that will not harm the environment, natural life and human health, but which can also respond to ever-increasing energy demand. Such sources of energy having names such as “alternative”, “clean” and “inexhaustible” are constantly on the agenda of world public opinion [5]. Among these renewable energy sources, Hydraulic Energy, Solar Energy, Geothermal Energy, Wind Energy, Wave Energy, Hydrogen Energy and Biomass Energy are gaining importance as sources that can meet energy needs in the coming centuries. It is predicted that with the long-term use of these resources, approximately three quarters of the world's energy needs will be met and environmental pollution, one of the major environmental problems, will be substantially reduced [6]. Non-renewable energy sources such as oil, coal and natural gas pollute the atmosphere and the environment, many toxic gases are released, however, this is not the case for the renewable energy sources. Therefore, renewable energy sources are both healthy and reliable sources and are also known as “Eco-Friendly Energy Sources”. In this context, renewable energy sources are envisaged to be clean and eco-friendly energy sources to meet the increasing energy needs of countries [7], [8].

The issue of renewable energy sources is not only a concept concerning the economy of the world and countries. It is also directly indispensable in order to ensure a better human life on this world. Therefore, education should become involved to introduce the necessity and importance of using renewable energy sources into the minds of individuals [9]. Today, especially in developed countries, the necessity of raising generations that do not pollute the environment and have knowledge about renewable energy sources is emphasized during the education process [10], because the importance of education in increasing environmental awareness and interest towards renewable energy sources is an undeniable reality [11], [12]. In this case, knowledge and sensitivity towards renewable energy sources has become a responsibility that should be present in all individuals. The most basic stage in the formation of this responsibility is seen as the education to be provided. In this context, sensitive and conscious individuals will be raised as a result of the integration of education with the efforts of family and neighborhood [6], [13]. Thus, the aim is to raise awareness of the field of renewable energy and to transfer this awareness to future generations. Hence, the fact that global energy production will affect developments in many areas and increase competition between communities, necessitates raising generations with sufficient knowledge and foresight about this issue.

In addition to revealing the potentials of renewable energy sources, the educational dimension of the recognition of these eco-friendly sources is just as important. The shortcomings in energy awareness originate from the lack of education and from indifference [14]. In general, it is thought that education is an important factor in acquiring cognition and behavior related to the use of renewable energy sources. The more knowledgeable and sensitive the teachers are about these eco-friendly resources, the more effective and easier it will be for students to gain knowledge, value and behavior concerning this issue. Thus, teachers who are knowledgeable about renewable energy sources can guide students by providing knowledge and competence on how to use these resources in daily life [15]. For this reason, the teachers' own attitudes towards renewable energy sources will also affect the attitudes of their students.

Regarding the results of the literature review, it is seen that studies in the field of education related to renewable energy sources have gained importance in recent years and the number of the studies has increased. In these studies, knowledge, attitude, self-efficacy, behavior awareness or the opinions of teachers, pre-service teachers and students in various branches about renewable energy sources were analyzed [16], [17], [9], [18], [19], [20], [21], [22], [6], [23], [2], [24], [25], [26], [27], [28], [29], [30]], [31], [32]. In addition, there are studies to develop scale related to renewable energy sources [13], [33], [27], [21]. The review of the studies showed that either the quantitative or the qualitative method is preferred. So, to date, not many mixed-method studies involving both qualitative and quantitative studies on renewable energy sources have been encountered. In this study, choosing the mixed method has allowed us to associate and compare quantitative results with qualitative results, enabling us to perform in-depth analysis.

Regarding the curriculum of primary education, it is seen that the topic of renewable energy sources is clearly included in Science course. Considering the fact that the Science course is given from the 3rd grade, it can be said that both Science and Classroom teachers who have specialized on this topic are needed. In this respect, the attitudes and opinions of pre-service Science and Classroom teachers, who are the teachers of the future, concerning renewable energy sources are very valuable. Because it is only possible to train knowledgeable students who are aware of this subject through teachers who are aware of this matter of renewable energy sources. Therefore, this study aimed to analyze the attitudes towards renewable energy sources of pre-service teachers studying in both Classroom Teaching and the Science Teaching programs in terms of different variables and to determine their opinions about renewable energy sources. Factors affecting the environmental behaviors of individuals and their attitudes are; gender, age, occupation, income and financial status, educational and cultural level, social and economic living environment [34]. In this study; gender, grade and family income variables were used. The following questions were addressed for the purpose of the study:

- Regarding the attitudes of pre-service science teachers towards renewable energy sources; are there any significant differences according to gender, grade and family income?
- Regarding the attitudes of pre-service classroom teachers towards renewable energy sources; are there any significant differences according to gender, grade and family income?

- Do pre-service science and classroom teachers' attitudes towards renewable energy sources differ significantly according to department variable?
- What are the opinions of pre-service science teachers about renewable energy sources?
- What are the opinions of pre-service classroom teachers about renewable energy sources?

2. Methodology

In this study the data were collected both quantitatively and qualitatively. The mixed method was preferred to achieve a healthier result from the data. The mixed method is a process involving both quantitative and qualitative methods within the research method of single or multi-stage studies [35]. The purpose in using this method is to synthesize the quantitative and qualitative results in a complementary way [36].

There are four issues to be decided when choosing mixed method patterns in a study. These are: 1) Level of Interaction Between Stages, 2) Relational Priority of the Stages, 3) Timing of the Stages and 4) The Process of Combining Stages [36]. In this research converging parallel pattern was preferred and the above steps were evaluated as follows: The quantitative and qualitative analysis stages will not affect each other and will have equal priority, these stages will be executed simultaneously and finally these stages will be analyzed separately and the results will be interpreted as a whole.

3. Sample

In order to collect the quantitative data of the study, 192 pre-service teachers (161 female, 31 male) from the Science Teaching Department of Akdeniz University Education Faculty and 181 (128 female, 53 male) pre-service teachers from the Classroom Teaching department participated in the study. Convenience sampling method was used in the quantitative stage for easy access to the study group [37]. In the sampling of the study group of the qualitative stage, the maximum diversity method from purposeful sampling approaches was used. The objective of the maximum diversity sampling method is to obtain a pattern that represent many differences [38]. In this regard, qualitative study group consisted of 16 voluntarily participating pre-service teachers, 8 students from Science Education and 8 from Classroom Education Departments, provided that 1 girl and 1 boy will be included for each grade level. All the necessary legal permissions having been obtained for the conduct of the study, and the principle of volunteering was taken into consideration in order to conduct surveys and interviews within the framework of the rules on ethics. The demographic characteristics of the pre-service Science and Classroom teachers who participated in the study are shown in Table 1.

Table 1. Demographic Characteristics of the Participants, Frequency and Percentage Distribution

Demographic Characteristics		Science Teaching		Classroom Teaching	
		N	%	N	%
Gender	Female	161	83.85	128	70.72
	Male	31	16.15	53	29.28
Grade	1st Grade	39	20.31	58	32.044
	2nd Grade	56	29.17	34	18.784
	3rd Grade	58	30.21	51	28.176
	4th Grade	39	20.31	38	20.994
Family Income	0-1000TL	21	10.94	21	11.61
	1001-2000TL	75	39.06	68	37.57
	2001-3000TL	47	24.48	46	25.41
	3001TL and more	49	25.52	46	25.41
Departments	Science Teaching	192	100	181	100
	Classroom Teaching				

4. Data Collection Tools

The quantitative data of the research was obtained through the "Attitude Scale for Renewable Energy Sources" and the qualitative data was obtained by a "Semi-Structured Interview Form" created by the researcher.

The quantitative data collection tool used in the research was the "Attitude Scale for Renewable Energy Sources", which has been developed by Tohit Güneş, Kazım Alat and Ali İbrahim Can Gözüm in 2013 [13] and consists of 26 5-point Likert type items with options "Completely Disagree", "Disagree", "Undecisive", "Agree" and "Completely Agree". Prior to use, the necessary permissions were obtained from all authors who have developed the scale. The variance explained by the scale was found to be 51.94% and the reliability was 0.87; these statistical analyses show that the attitude scale for renewable energy sources is a valid and reliable data collection tool. In order to collect the data about the variables to be analyzed in the study, a Personal Information Form prepared by the researcher was added to the beginning of the questionnaire.

In the process of obtaining qualitative data, a semi-structured interview form, created by the researcher was used. The interview is the chatty interaction between two or more individuals using verbal and nonverbal communication tools and techniques for a specific purpose [39]. In a semi-structured interview, questions can be prepared in advance and also can be derived during the course of the interview. The aim here is to add depth to the research and to make the research more explanatory through extending it [40]. The semi-structured interview form consisting of 7 questions, prepared for the in-depth analysis of the attitudes revealed by the "Attitude Scale for Renewable Energy Sources" was prepared by the person who conducted the research. The questions in this interview form were examined and corrected by an expert. In addition to these questions, further questions were asked according to the course of the

interview. In order to prevent data loss, interviews were recorded with a voice recorder.

5. Data Analysis

In the analysis of the quantitative data, the distribution of the data was checked first. Normal distribution of the data set allowed independent samples t-test and one-way analysis of variance (ANOVA) to be used. Content analysis was performed for the analysis of the qualitative data. "PST" codes were used for pre-service science teachers, whereas "PCT" codes were used for pre-service classroom teachers. In the analysis of qualitative data, frequency and percentage figures were calculated by creating themes and codes, and sample opinions were included in the findings section. As a result of this qualitative data analysis, the reliability of the study was calculated by the formula of Miles and Huberman (1994) [41] (Reliability = [Consensus / Consensus + Disagreement] x 100). This formula shows the percentage of concordance between the evaluations of experts and researchers in qualitative studies. If the concordance rate is over 90%, the establishment of reliability is ensured [41]. In this study, the concordance rate of Science teachers' opinions about renewable energy sources was calculated as 91%, which showed that the validity and reliability of the study was achieved.

6. Results

6.1. Results of Quantitative Data

The T-test was used to check whether the gender variable created a difference in the attitudes of the pre-service science teachers towards renewable energy sources, whereas one-way analysis of variance (ANOVA) was used for the grade and family income variables. The results of this analysis are given below, Table 2 for gender variable, Table 3 for grade variable and Table 4 for family income variable.

Table 2. Preservice Science Teachers' Attitudes towards Renewable Energy Sources according to Gender

Gender	N	X	SS	sd	t	p
Female	161	96.44	9.74	190	.336	.73
Male	31	95.74	14.12			

*p>0.05

Regarding Table 2, there is no significant difference between the pre-service science teachers' attitudes towards renewable energy sources according to their gender. [t (190) = .336, p> .05]. As a result, it is concluded that there is no significant difference between female and male pre-service science teachers' attitude towards renewable energy sources.

Table 3. Preservice Science Teachers' Attitudes towards Renewable Energy Sources according to Grade

Grade	N	X	SS	F	sd	p
1st Grade	39	96.74	9.50	2.462	3-188	.06
2nd Grade	56	93.50	10.80			
3rd Grade	58	97.80	10.65			
4th Grade	39	99.26	10.33			
Total	192	96.32	10.53			

***p>0.05**

Table 3 revealed that there is no significant difference between the pre-service science teachers' attitudes towards renewable energy sources according to grade [F (3,188) = 2.462, P>.05].

Table 4. Preservice Science Teachers' Attitudes towards Renewable Energy Sources according to Family Income

Family Income	N	X	SS	F	sd	p
0-1000TL	21	94.43	14.13	.596	3-188	.61
1001-2000TL	75	96.77	9.40			
2001-3000TL	47	97.76	8.44			
3001TL and more	49	97.60	12.21			
Total	192	96.32	10.53			

***p>0.05**

Table 4 shows that there is no significant difference between pthe reservice science teachers' attitudes towards renewable energy sources according to family income [F (3,188) = .596, P>.05].

Similarly, the t-test was used to check whether the gender variable created a difference in the attitudes of the pre-service classroom teachers towards renewable energy sources, whereas one-way analysis of variance (ANOVA) was used for the grade and family income variables. The results of the analysis are given below, Table 5 for gender variable, Table 6 for grade variable, and Table 7 for family income variable.

Table 5. Preservice Classroom Teachers' Attitudes towards Renewable Energy Sources according to Gender

Cender	N	X	SS	sd	t	p
Female	128	98.72	9.24	179	3.231	.00*
Male	53	93.26	12.64			

***p<0.05**

Table 5 revealed a significant difference between the pre-service classroom teachers' attitudes towards renewable energy sources according to gender. [t (179) = 3.231, p< .05]. As a result, it is concluded that there is a significant difference between the female and the male pre-service classroom teachers' attitude towards renewable energy sources.

Table 6. Preservice Classroom Teachers' Attitudes towards Renewable Energy Sources according to Grade

Grade	N	X	SS	F	sd	p
1stGrade	58	96.98	11.63	.093	3-177	.96

2nd Grade	34	97.51	10.97
3rd Grade	51	96.60	9.35
4th Grade	38	97.68	10.63
Total	181	97.12	10.61

***p>0.05**

According to Table 6, there is no significant difference between the pre-service classroom teachers' attitudes towards renewable energy sources according to grade [F (3,177) = .093, P>.05].

Table 7. Preservice Classroom Teachers' Attitudes towards Renewable Energy Sources according to Family Income

Family Income	N	X	SS	F	sd	p
0-1000TL	21	97.09	8.04	.933	3-177	.42
1001-2000TL	68	98.39	10.12			
2001-3000TL	46	97.36	9.93			
3001TL and more	46	95.02	12.79			
Total	181	97.12	10.61			

***p>0.05**

Table 7 shows that there is no significant difference between the pre-service classroom teachers' attitudes towards renewable energy sources according to family income [F (3,177) = .933, p>.05].

Table 8. Preservice Teachers' Attitudes towards Renewable Energy Sources according to Department

Department	N	X	SS	sd	t	p
Science Teaching	192	96.33	10.52	371	.721	.47
Classroom Teaching	181	97.12	10.61			

***p>0.05**

In Table 8, there is no significant difference between the attitudes of the pre-service science and classroom teachers towards renewable energy sources [t (371) =. 721, p> .05]. As a result, there is no significant difference between the pre-service science and the classroom teachers' attitude towards renewable energy sources.

6.1. Results of Qualitative Data

In the qualitative part of the study, the opinions of the Pre-service Science and the Classroom Teachers about Renewable Energy Sources were analyzed by content analysis and thematic coding. In the interviews conducted with 8 Science and 8 Classroom Pre-service Teachers, 4 common themes were identified. The themes were set based upon the interview questions that have been created as a result of the literature review and from the differences of opinion that emerged in the course of the interview. In addition to common codes, different codes have emerged under common themes for the pre-service science and the classroom teachers. The opinions of the pre-service science teachers are shown in Table 9, while the opinions of the pre-service classroom teachers are shown in Table 1.

Table 9. Preservice Science Teachers' Opinions about Renewable Energy Resources

Theme	Codes	Sample of Preservice Science Teachers' Opinion	f	%
Definition of Renewable Energy	Self-Generating Energy	"*It is an energy that can regenerate itself as long as it is used, even if it is not used, and that is self-generated and that can return to us as much or more as it is used (PST5)*".	2	14.28
	Inexhaustible Energy	"*Renewable energy, as the name indicates, renew itself continuously, it is self-renewable, continuous, that can be used infinitely, with objects that we can call inexhaustible, for example, solar energy wind energy never runs out. The sun has existed for millions of years. Its energy will last forever, but the fuel is not so, there is a certain amount in the world, it will definitely run out after a certain time, it cannot be renewed, but the sun is always there (PST2)".*	8	57.14
	Interconverting Energy	"*…is a non-destructive, interchangeable, clean, nature-friendly energy (PST3)*".	4	28.57
Necessity of	Eco-Friendly Energy	*"Renewable energy sources provide eco- friendly energy. If we increase the use of renewable energy sources, then the continuity of energy is ensured. They don't pollute the world because they don't pollute the environment and it's healthier so we should use renewable energy sources (PST4)".*	*4*	*30.77*
	For a good future	"*Since non-renewable resources will run out one day, if we use renewable resources in a better way, we will both benefit from renewable energy and leave future generations a good future without energy shortages (PST2)*".	3	23.08
	Exhaustion Risk	"*…for example, oil, coal, they exist in the earth, but they will run out after a*	6	46.15

Renewable Energy Resources	and Dangers of Other Energy Resources (Fossil Fuels)	*certain time, their decrease is discussed as the human population increases, now, the use of electric cars in America has become quite common. People are aware of this, and obviously, it is necessary to take precautions now because the human population increased to 7 billion and the higher the rate, the more is the increase. Human's energy need is increasing every day. So, the exhaustion of these is clear. As I said, after a while they will run out, people have to meet these needs somehow, how the transportation on earth will be realized when fuel or oil runs out, these problems will occur after a while, of course, we need to take our precaution and therefore renewable energy sources are very necessary and even mandatory now (PST2)*".		
Dissemination of the Use of Renewable Energy Resources	Raising Awareness	"*...people should be enlightened, as I already said, this is something that can easily payback itself after a while, I mean, the sun is unlimited you don't pay any money for it, you don't give any money to the wind, only a certain amount of money is paid for the mechanism, but you'll already get it back later, if we spread this to people, it will be profitable for both us and nature and the world. People should be enlightened (PST2)*".	7	41.18
	Education	"*... regarding the damage of petroleum fuels to the nature, erosion, etc., most of them are already underpinned by education. If we explain the damages of non-renewable energy sources through education and direct them to renewable sources, everyone will use them more. Honestly, I think that the better we educate the new generation, the more conscious we make them, the more careful they will be (PST2)*".	6	35.29
	Conference, Project, Seminar etc.	"*...renewable energy sources can be discussed, students and teachers can be informed on this issue, projects can be conducted. Conferences, seminars can be organized (PST4)*".	4	23.53

* Some of the preservice science teachers who participated in the study stated more than one opinion

As a result of the interviews with the pre-service science teachers, 3 themes were created: "Definition of Renewable Energy", "Necessity of Renewable Energy Sources" and "Dissemination of Renewable Energy Sources" the codes and some example of opinions under these themes are shown in Table 9.

More than half (57.14%) of the pre-service science teachers defined renewable energy as inexhaustible energy. 46.15% of them stated that renewable energy is necessary because of the "Dangers and Exhaustion Risk of Other Energy Sources". 35.29% of the pre-service science teachers' responses on how to spread the use of renewable energy sources was through "Education".

Table 10. Preservice Classroom Teachers' Opinions about Renewable Energy Resources

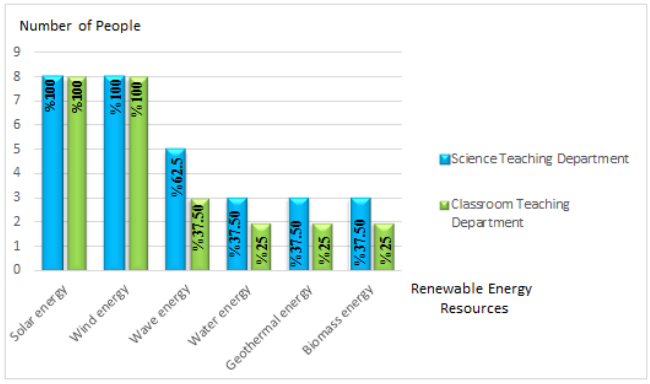
Theme	Codes	Sample of Preservice Classroom Teachers' Opinion	f	%
Definition of Renewable Energy	Self-Generating Energy	"Renewable energy is the energy that is self-existent in nature and inexhaustible (PCT)"	2	22.22
	Inexhaustible Energy	"Renewable energy can also be called sustainable energy. So, I can say that it is the energy that can be produced continuously and does not disappear, that can last forever (PCT8)".	7	77.78
Necessity of Renewable Energy	Eco-Friendly Energy	"The non-renewable energy sources in out surrounding are, for example, coal, then lignite, which are non-renewable energy sources. Their environmental damage is often high. Renewable energy sources are more environmentally sensitive and eco-friendly energy sources. They are very necessary and important due to little environmental damage (PCT2)".	*3*	*30.00*
	Exhaustion Risk and Dangers of Other Energy Resources	"I think the major reason why renewable energy sources are necessary is that other energy sources have huge damages to our ecosystem and that this affects the lives of us and all organisms negatively (PCT6)".	4	40.00

Resources	(Fossil Fuels)			
	Economical	"We generate up to a certain amount of energy with natural gas or geothermal energy, but if we use renewable energy sources such as solar energy and wind energy, our country will rise economically. Because renewable energy sources are more cost effective (SÖ8)".	3	30.00
	Raising Awareness	"We need to raise public awareness and explain the benefits and harms. If we announce this to the public in this way, the public will do so if they want. This is something that our government can do (PCT2)".	3	21.43
Dissemination of the Use of Renewable Energy Resources	Education	"We should start by giving trainings to spread the use of these resources. We will realize it by starting to give it to our students first, and then holding meetings in villages, towns or public education centers, you know, for example, the best point in the village to gather are the coffeehouses or we can raise the public awareness by gathering them elsewhere (PCT1)".	3	21.43
	Conference, Project, Seminar etc.	"Tubitak-style science activities, projects, for example, they can apply to such activities again, they can do an activity in which they will learn students' opinions and knowledge. I think this will be effective in dissemination (PCT4)".	3	21.43
	Advertisement	"…we can spread it by showing public service announcement, by providing information about it via mock-ups (PCT4)".	3	21.43

* Some of the preservice classroom teachers who participated in the study stated more than one opinion.

As a result of the interviews with the pre-service classroom teachers, 3 themes were created: "Definition of Renewable Energy", "Necessity of Renewable Energy Sources" and "Dissemination of Renewable Energy Sources", the codes and some example of opinions under these themes are shown in Table 10.

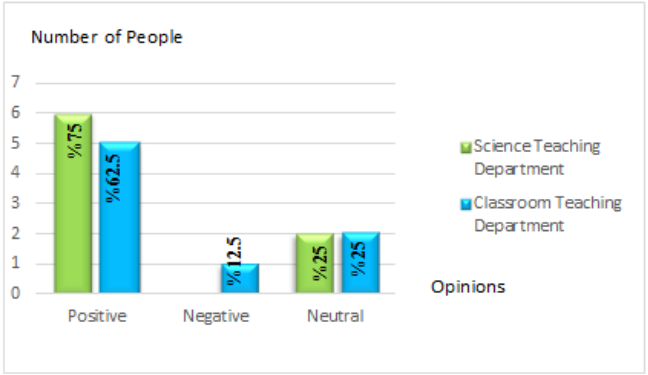
In the data obtained from the pre-service classroom teachers' opinion about what renewable energy means, 77.78% stated that renewable energy is "inexhaustible energy". 40.00% of the pre-service teachers stated that renewable energy is necessary because of the "Dangers and Exhaustion Risk of Other Energy Sources". 21.43 % of pre-service classroom teachers' responses on how to spread the use of renewable energy sources was through "Awareness raising", "Education", "Conference, Project, Seminar etc." and "School curriculum".



Graph 1. Renewable Energy Sources

Graph 1 indicates that solar energy and wind energy, renewable energy sources, are the resources that are known by 100% of both pre-service science teachers and classroom teachers. Regarding wave energy, 62.5% of pre-service science teachers were aware of this, while this ratio was 37.5% among pre-service classroom teachers. 37.5% of pre-service science teachers and 25% of pre-service classroom teachers are aware of water energy, geothermal energy and biomass energy from renewable energy sources.

The answers of the pre-service science and the classroom teachers to the question "What is the future use of renewable energy sources?" were categorized as "Positive, Negative and Neutral" and the comparative results are shown in Graph 2.



Graph 2. Future Use of Renewable Energy Sources

In Graph 2, the opinions and percentages regarding the future use of renewable energy sources are indicated. Pre-service science teachers was the group with the most positive (75%) and no negative (0%) opinion. This was 62.5% positive and 12.5% negative for pre-service classroom teachers. The ratio of pre-service teachers who were neutral about the future use of renewable energy sources was found to be 25% in both pre-service teachers' groups The following are the examples of opinions get from pre-service Science and Classroom Teachers.

"… as non-renewable energy sources are going to run out, we will work on them and I think that in 50 years, everything will work with renewable energy sources (PST5-POSITIVE)".

"I'm afraid I can't say anything positive. Because the course of events shows that even though international organizations have been established in the world, they don't have much impact in case of a plight. For example, there are countries producing nuclear energy, but these international organizations cannot engage in any deterrent activities. Unfortunately, they don't have that much power in their hands and the course of events is not promising (PCT6-NEGATIVE)).

"…there may be many things we don't see in the news. So, I have no idea about it (PST6-NEUTRAL)

7. Conclusion, Discussion and Suggestions

7.1. Conclusion from the Quantitative Data, Discussion

In this study, the differentiation of pre-service science and classroom teachers' attitudes towards renewable energy sources according to gender, grade, family income and their opinions about renewable energy sources were examined.

As a result of this study, it was found that gender did not create a significant difference in pre-service science teachers' attitudes towards renewable energy sources. This result is similar to the studies of Emlik (2017) [28], Bilen et al. (2013) [6], Çelikler and Kara (2011) [23], and Bozdoğan and Yiğit (2014) [20]. However, according to the result of the study titled "Analysis of Pre-service Teachers' Attitudes Towards Renewable Energy" by Fırat, Sepetçioğlu and Kiraz (2012) [22], a significant difference was found between the pre-service teachers' attitudes towards renewable energy according to gender, in favor of males. In addition, the results did not overlap with the results of the study of Karatepe, Varbek Nese, Keçebaş and Yumurtacı (2012) [42]. There was no significant difference in the attitudes of pre-service science teachers towards renewable energy sources according to grade variable. This result is consistent with the study of Emlik, (2017) [28], where there was no significant difference between the attitudes of pre-service teachers towards renewable energy sources according to their grades. No significant difference was found between the attitudes of pre-service science teachers towards renewable energy sources according to family income. Similarly, Emlik, (2017) [28] 's study showed that the attitudes towards renewable energy sources did not differ according to family income. In the study of Mutlu (2016) [43], there was no significant difference in the awareness of renewable energy sources according to family income, findings which is also similar to this study.

Gender has created a significant difference in the attitudes of pre-service classroom teachers towards renewable energy sources. This difference was in favor of female pre-service classroom teachers. Kartepe et al. (2012) [39]'s study showed that the attitudes of female students towards renewable energy sources were higher than those of male students, which overlaps with the result of this study. However, this result doesn't not match the results of the studies performed by Emlik (2017) [28], Bilen et al. (2013) [6], Celikler and Kara (2011) [23], Bozdogan and Yigit (2014) [20], Firat et al. (2012) [22]. Grade and family income did not create a significant difference in the attitudes of pre-service classroom teachers towards renewable energy sources. Similarly, in the studies of Zarnikau (2003) [44], Emlik (2017) [28], it was found that there was no significant difference in attitudes towards renewable energy sources according to grade. Furthermore, in a similar study in the literature, it was found that there were no differences according to family income in the attitude towards renewable energy sources [28].

It was checked whether there is a difference between the attitudes of the pre-service science and the classroom teachers towards renewable energy sources. As a result of the analysis, it was found that pre-service classroom teachers had higher descriptive attitude scores than the pre-service science teachers, but this difference was not statistically significant. It is seen that in the literature this result overlaps with the results of Emlik (2017) [28] and it does not match the results of Bozdoğan and Yiğit (2014) [20].

7.2. Conclusion from the Qualitative Data, Discussion

In this study, in which the opinions of pre-service science and classroom teachers about renewable energy sources were collected, three common themes were created: definition of renewable energy, necessity of renewable energy sources, and the dissemination of the use of renewable energy sources and thematic coding was performed for both departments. It was found that both pre-service Science and Classroom Teachers mentioned "Inexhaustible Energy" and "Self-Generating Energy" as the definition of renewable energy. In addition to these definitions of renewable energy, the pre-service Science teachers also stated that it is "Interconverting Energy". The review of the results coming from these outcomes of the study showed that the pre-service Science and Classroom Teachers had unscientific knowledge about the definition of renewable energy. In a study with similar results to this one, "Pre-service Science Teachers' Knowledge on Renewable Energy Sources", by Karakaya-Cırıt (2017) [30], the pre-service science teachers gave un-scientific explanations when defining renewable energy. Regarding the literature, in the

study of Çolak, Kaymakcı and Akpınar (2015) [9], entitled, "The Place of Renewable Energy Sources on Social Studies Textbooks and Pre-service Teachers' Opinions", 53.33% of the answers given to the definition of renewable energy was "renewable energy is Inexhaustible type Energy", which overlaps with the findings of this study.

The Pre-service Science and Classroom Teachers who stated their opinion about the necessity of renewable energy sources mostly mentioned "Dangers and Exhaustion Risk of Other Energy Sources". In addition, the pre-service teachers in both departments indicated that renewable energy sources are necessary because they are "Eco-friendly Resources". Unlike non-renewable energy sources and which makes the importance of these resources even more significant, unlike oil, coal and natural gas, renewable energy sources do not cause damage to the environment. Therefore, these resources are also called "Eco-Friendly Energy Sources [7], [8]. Pre-service science teachers also emphasized that renewable energy is necessary "for a good future", while pre-service classroom teachers stated that it is necessary because it is "economic". The support given by Akçöltekin and Doğan (2013) [29] to renewable energy sources; the declaration of Colak et al. (2015) [9] that renewable energy sources are necessary considering their advantages, such as the continuation of the natural balance, environmental and reliable energy supply, cheap and inexhaustible energy supply, raising the standard of living and eliminating inequality, are parallel with the results of this research.

Pre-service Science and Classroom Teachers who expressed their opinion about the dissemination of the use of renewable energy sources, mostly stated that this spread can be achieved by "Raising Awareness", "Education", "Conference, Project, Seminar", etc. In addition to these ways of dissemination, the pre-service classroom teachers mentioned that awareness of renewable energy sources could be spread by adding them to the "School Curriculum" and increasing the "Advertisements" for renewable energy sources. In a similar study, Cebesoy and Karışan (2017) [16] found that pre-service teachers preferred to teach renewable energy sources to students via the methods such as "current news, maps, project development for renewable energy sources, and invitation of experts to the classroom", etc.

It was observed that from renewable energy sources, all pre-service Science and Classroom Teachers had knowledge about solar and wind energy. It was found that pre-service science teachers mentioned wave energy more than the pre-service classroom teachers. Geothermal and biomass energies were observed to be the least known sources of renewable energy by pre-service teachers of both departments. In this case, it can be said that the pre-service Science and Classroom Teachers do not have sufficient information about renewable energy sources. In the study of Karakaya-Cırıt (2017) [30], it was observed that most of the pre-service science teachers have mentioned solar and wind energy, some of them mentioned "geothermal, biomass, hydroelectric and wave energy"' in their answers to what renewable energy sources are, but they could not provide an adequate scientific explanation, in consequence they concluded that pre-service teachers have insufficient knowledge. Along with this result, the results of this study overlap with the results of the studies performed by Cebesoy and Karışan (2017) [16], Çelikler and Kara (2011) [23], Colak et al. (2015) [9], Bilen et al. (2013) [6].

The most positive opinions about the future use of renewable energy sources were mentioned by the pre-service science teachers. Furthermore, the pre-service teachers in this study group did not state any negative opinion. However, there are people who had no opinion about the future use of renewable energy sources, that is to say, people who had a neutral view among both pre-service science teachers and pre-service classroom teachers. Similarly, in the study conducted by Karadeniz-Bayrak, Dilek-Eren and Gürdal (2014) [45], it was seen that the majority of the first and fourth grade pre-service teachers in the old and new program have positively approached alternative energy.

7.3. Suggestions

Today, the importance assigned to renewable energy sources, also known as eco-friendly energy sources, is increasing all around the world. Therefore, courses related to renewable energy sources should be included in the course catalogues of the faculties of education atpre-service universities. In addition, research centers focusing on renewable energy should be established and pre-service teachers should be actively involved in activities and projects.

References

[1] M. C. Çakar, Ü. Basaran-Filik, and M. Kurban, "Yenilenebilir Enerji Kaynakları ve Ulaşım Sistemlerinde Kullanım Uygulaması", V. Yenilenebilir Enerji Kaynakları Sempozyumu Bildiriler Kitabı, Diyarbakır, pp. 237-242, 2009.

[2] E. Saraç, and H. Bedir, "Primary school teachers related to perceptions of renewable energy sources on the qualitative research", Science Journal of Turkish Military Academy, vol. 24, no. 1, pp. 19-45, 2014. [In Turkish].

[3] N. Özdemir, and E. O. Çobanoğlu, "Prospective teachers' attitudes towards the use of nuclear energy and the construction of nuclear plants in turkey", Hacettepe University Journal of Education, no. 34, pp. 218-232, 2008. [In Turkish].

[4] Z. Aksan and D. Çelikler, "Pre-Service elementary teachers' opinions about global warming" Eskişehir Osmangazi University Sosyal Bilimler Dergisi vol. 14, no. 1, pp. 49-67, 2013. [In Turkish].

[5] S. Hayli, "L'importance de energie du vent, son etat actuel en turquie et dans le monde" Fırat University Sosyal Bilimler Dergisi vol. 11, no. 1, pp. 1-26, 2001. [In Turkish].

[6] K. Bilen, M. Özel, and, A. Sürücü, "Pre-service science teachers' awareness about renewable energy", Dumlupınar Üniversitesi Sosyal Bilimler Dergisi, no. 36, pp. 101-112, 2013. . [In Turkish].

[7] R. Biçici, Türkiye'de enerji ekonomisi, Unpublished Master Thesis. Zonguldak Karaelmas University, Zonguldak, 2008. [In Turkish].

[8] K. Yıldız, S. Sipahioğlu, and M. Yılmaz, Çevre Bilimi, Ankara: Gündüz Education and Publishing, 2000.

[9] K. Çolak, S. Kaymakcı and M. Akpınar, "The status of renewable energy resources in the Turkish social studies textbooks and prospective teachers' perceptions", Journal of Educational Sciences, vol. 41, pp. 59-76, 2015. [In Turkish].

[10] M. Hugerat, S. Ilyian, Z. Toren, and F. Anabosi, "Solar village: educational initiative for Kids", Journal of Science Education and Technology, vol. 12, no. 3, 309-315, 2003.

[11] H. S. Tortop, N. Ç. Bezir, M. Uzunkavak, and, N. Özek, "Öğrencilerin Güneş Enerjisi ve Uygulamaları Konusundaki Başarıları ile Çevreye İlişkin Tutumları Arasındaki İlişkinin Araştırılması", Güneş Enerjisi Sistemleri Sempozyumu ve Sergisi, pp. 62-66, 2007.

[12] H. S. Tortop, and N. Özek, The meaningful field trip inproject based learning; the solar energy and its usage areastopic", Hacettepe University Journal of Education, no. 44, pp. 300-307, 2013. [In Turkish].

[13] T. Güneş, K. Alat, and, A. İ. C. Gözüm, "Fen öğretmeni adaylarına yönelik yenilenebilir enerji kaynakları tutum ölçeği: geçerlik ve güvenirlik çalışması", Journal of Educational Sciences Research, vol. 3, no. 2, pp. 270-271, 2013.

[14] M. Newborough, and D. Probert, "Purposeful energy education in the UK", Applied Energy, no. 48, pp. 243-259, 1994.

[15] G. Liarakou, C. Gavrilakis, and E. Flouri, "Secondary school teachers' knowledge and attitudes towards renewable Energy Sources", Journal of Science Education and Technology, vol. 18, no. 2, pp. 120-129, 2009.

[16] Ü. B. Cebesoy, and, D. Karışan, "Investigation of preservice science teachers' knowledge, teaching efficacy perceptions and attitude towards renewable energy sources", YYU Journal Of Education Faculty, vol. 14, no. 1, pp. 1377-1415, 2017. [In Turkish].

[17] A. Zyadin, A. Puhakka, P. Ahponen, and P. Pelkonen, "Secondary school teachers' knowledge, perceptions, and attitudes toward renewable energy in Jordan", Renewable Energy, 62, pp. 341-348, 2014.

[18] E. Benzer, B. Karadeniz-Bayrak, C. Dilek-Eren, and, A. Gürdal, "Knowledge and opinions of the primary students about energy and energy resources: The comparison of current and previous curriculum", International Journal of Social Science, vol. 25, no. I, pp. 285-298, 2014.

[19] A. Kılınç, M. Stanisstreet, and E. Boyes, "Incentives and disincentives for using renewable energy: Turkish students' ideas", Renewable and Sustainable Energy Reviews, no. 13, pp. 1089-1095, 2009.

[20] A. E. Bozdoğan, and, D. Yiğit, "Investigation of prospective teachers' opinions to the alternative energy sources according to different variables", Electronic Journal of Education Sciences, vol. 3, no. 6, pp. 113-130, 2014. [In Turkish].

[21] D. Çelikler, and, Z. Aksan, "The development of an attitude scale to assess the attitudes of high school students towards renewable energy sources", Renewable and Sustainable Energy Reviews, no. 54, pp. 1092-1098, 2016.

[22] A. Fırat, H. Sepetçioğlu, and, A. Kiraz, "Analysis of the attitudes of teacher candidates about renewable energies", Hacettepe University Journal of Education, no. 1, pp. 216-224, 2012. [In Turkish].

[23] D. Çelikler and F. Kara, "Pre-service elementary mathematics and social science teacher's awareness about renewable energy" 2nd International Conference on New Trends in Education and Their Implications, Ankara, pp. 530-539, 2011. [In Turkish].

[24] E. Çelik, Yenilenebilir enerji kaynaklarının fen eğitiminde önemi, Unpublished Master Thesis, Mersin University, Mersin, 2017.

[25] D. Bıyıklı, Öğretmen ve öğretmen adaylarının yenilenebilir enerji kaynaklarına yönelik görüşlerinin incelenmesi, Unpublished Master Thesis, Mersin University, Mersin, 2018.

[26] D. Çelikler, A. Yılmaz, and, Z. Aksan, "Determining the attitudes towards renewable energy sources of twelfth grade students attending different types of high schools", Journal Of Educational And Instructional Studies In The World vol. 6 no. 1 (Special Issue), pp. 2146-7463, 2016.

[27] İ. Morgil, N. Seçken, A. S. Yücel, Ö. Ö. Öskay, S. Yavuz, and E. Ural, "Developing a renewable energy awareness scale for pre-service chemistry teachers", Turkish Online Journal of Distance Education, vol. 7, no. 1, pp. 63-74, 2006.

[28] H. Emlik, Öğretmen adaylarının yenilenebilir enerji kaynaklarına karşı tutumları ile enerjinin etkin kullanımı ve teknolojik kirlilik farkındalıkları arasındaki ilişkinin incelenmesi, Unpublished Master Thesis, Kahramanmaraş Sütçü İmam University, Kahramanmaraş, 2017.

[29] A. Akçöltekin, and, S. Doğan, "The determination of the classroom teachers' attitudes towards renewable energy", Journal of Academic Social Science Studies, vol. 6, no. 1, pp. 143-153, 2013. [In Turkish].

[30] D. Karakaya-Cırıt, "Pre-service science teachers' (PST) knowledge involving the topic of renewable energy sources", Turkish Journal of Educational Studies vol. 4, no. 3, pp. 21-43, 2017. [In Turkish].

[31] P. Halder, S. Havu-Nuutinen, J. Pietarinen, A. Zyadin, and, P. Pelkonen, "Subject knowledge and perceptions of bioenergy among school teachers in india: Results from a Survey", Resources, vol. 3, no. 4, pp. 599-613, 2014.

[32] H. S. Tortop, Awareness and misconceptions of high school students about renewable energy resources and applications: Turkey case. Energy Education Science and Technology Part B: Social and Educational Studies, vol. 4, no.3, pp. 1829-1840, 2012.

[33] H. Yakut-İpekoğlu, İ. Üçgül, and G. Yakut, "Renewable energy perception scale: reliability and validity", Süleyman Demirel University Journal of YEKARUM, vol. 2, no. 3, pp. 20-26, 2014. [In Turkish].

[34] Atasoy, E., Çevre için eğitim: ilköğretim öğrencilerinin çevresel tutum ve çevre bilgisi üzerine bir çalışma. Unpublished Doctoral Thesis, Uludağ University, Bursa, 2005.

[35] C. Teddlie, and, A. Tashakkori, Karma yöntem araştırmalarının temelleri, trans. Y. Dede and, S. B. Demir, Ankara: Anı Publishing, 2015.

[36] J. Creswell, and, V. Clark, Karma Yöntem Araştırmaları, Eds. Y. Dede and, S. B. Demir, Ankara: Anı Punlishing, 2015.

[37] Yıldırım, A. and Şimşek, H., Sosyal Bilimlerde Nitel Araştırma Yöntemleri. Ankara: Seçkin Publishing, 2018.

[38] Patton, M. Q., Qualitative Research & Evaluation Methods. Thousand Oaks, CA: Sage Publication, 2002.

[39] H. Sağırekmekçi, Tahmin-gözlem-açıklama (TGA) stratejisine dayalı olarak hazırlanan fen ve doğa etkinliklerinin, okul öncesi öğrencilerinin bilimsel süreç becerilerine etkisi, Unpublished Master Thesis. Mustafa Kemal University, Hatay, 2016.

[40] A. Türnüklü, "Eğitimbilim araştırmalarında etkin olarak kullanılabilecek nitel bir araştırma tekniği: görüşme", Kuram ve Uygulamada Eğitim Yönetimi, no. 24, pp. 543-559, 2000.

[41] M. B. Miles, and, A. M. Huberman, Qualitative Data Analysis: An Expanded Source Book, 2nd. ed. CA: Sage Publications, 1994.

[42] Y. Karatepe, N. Varbak, A. Keçebas, and M. Yumurtacı, "The levels of awareness about The renewable energy sources of university students in turkey", Renewable Energy an International Journal, no. 44, pp. 174-179, 2012.

[43] O. Mutlu, Fen dersleri (fizik, kimya ve biyoloji) öğretmen adaylarının yenilenebilir enerji farkındalık düzeylerinin incelenmesi, Unpublished Master Thesis. Süleyman Demirel University, Isparta, 2016.

[44] J. Zarnikau, "Consumer demand for 'green power' and energy efficiency", Energy Policy, no. 31, pp.1661-1672, 2003.

[45] E. Benzer, B. Karadeniz-Bayrak, C. Dilek-Eren, and, A. Gürdal, "Knowledge and opinions ofteacher candidates about energy and energy resources", International Online Journal of Educational Sciences, vol. 6, no. 1, pp. 243-257, 2014.