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Pre-service Teachers' Perception of Renewable Energy Sources: A Case Study of Düzce University

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Abstract. This research aimed to investigate the perceptions of pre-service teachers regarding renewable energy sources (RES), their tendency to use renewable energy, their opinions about the future use of such sources, and to determine whether they possess fundamental knowledge about renewable energy sources. To this end, the Renewable Energy Perception Scale, a 5-point Likert scale, was administered to a total of 755 pre-service teachers in the Science Teaching and Primary Teaching Departments in the Education Faculty of Düzce University. The scale has three sub-dimensions, namely "Renewable Energy Knowledge", "Renewable Energy Future Vision", and "Renewable Energy Tendency". In the whole scale and its sub-dimensions of "Renewable Energy Knowledge" and "Renewable Energy Tendency", it was found that the pre-service primary teachers had a statistically significantly better perception of renewable energy sources than the pre-service science teachers. Additionally, younger participants demonstrated a statistically significant better perception of the "Renewable Energy Tendency" sub-dimension. A statistically significant gender-based difference was observed in the "Renewable Energy Future Vision" sub-dimension. However, no significant gender-based difference was found for the entire scale and the other sub-dimensions. This study underscores the importance of examining pre-service teachers' perception of renewable energy for their enhanced ability to teach these sources to their future students.

Keywords: Pre-Service Teachers, Perception of Ecological Knowledge, Renewable Energy Sources.

1. Introduction

The energy needs of countries are increasing day by day and they are presently met largely by fossil fuels such as coal and oil (Koroneos, et al., 2003; Satman, 2007). The limited resources such as coal, oil, and natural gas, which have been widely used all over the world, have caused serious damage. The main consequence of using these fuels is an increase in the ratio of greenhouse gases such as carbon dioxide (CO2), methane (CH4), and nitrous gas derivatives (NO, N2O, and NO2) in the atmosphere, and the resulting global warming, acid rains, climate change, disasters, and migrations (Liarakou, et al., 2009). All these give rise to environmental, social, and economic threats to the future of the world. When the related literature is examined, it is seen that renewable energy sources such as solar, wind, geothermal, hydroelectric, hydrogen, sea (as a wave, tidal, and current energy), and biomass energies are regularly discussed (Koroneos et al., 2003). Renewable energy sources are known to be more environmentally friendly than fossil fuels (Koroneos et al., 2003). The first step in training generations with the awareness of renewable energy sources is to train teachers' consciousness of the importance of renewable energy sources. If countries are aiming to increase their use of renewable energy sources, they need to develop strategies that will improve knowledge, perception, awareness, and attitudes. This can be achieved through education (Liarakou et al., 2009). To do so, teachers and pre-service teachers must have the appropriate knowledge, perception, awareness, and attitudes about the use of renewable energy sources.

1.1. Problem Statement

The importance of improving teachers' and pre-service teachers' perceptions of renewable energy sources is frequently emphasized in the literature (Liarakou et al., 2009). Teachers' knowledge and attitudes towards renewable energy are important because they play a crucial role in educating and shaping the mindset of future generations regarding sustainable development (Liarakou et al., 2009). The increase in knowledge, perception, and awareness among teachers and pre-service teachers and their positive attitude toward renewable energy sources will also reflect on their teaching practices (Liarakou et al., 2009). However, some scholars have reported that teachers' knowledge is limited (Liarakou et al., 2009; Zyadin et al., 2014). For example, Liarakou et al. (2009) found that teachers had little knowledge of renewable energy sources but had a positive attitude toward using them, and they had sufficient knowledge of solar and wind energy. The teachers were found to not prefer to teach classes on renewable energy because of the inadequacies in their past teacher education (Liarakou et al., 2009).

1.2. Related Research

Zyadin et al. (2012) investigated the knowledge, perceptions, and attitudes of students toward renewable energy in a country that was overly dependent on fossil fuels despite the widespread presence of renewable energy sources. According to the results of the study, students showed a limited ability to differentiate between renewable and non-renewable sources. Also, more than 50% of them were unaware of biofuels such as biodiesel and bioethanol.

Saraç and Bedir (2014) discovered that some primary school teachers had a lack of knowledge and held several misconceptions about renewable energy sources. For example, they were confused between renewable and non-renewable energy sources. Saraç and Bedir (2014) concluded that educational trips, materials, and seminars related to the teaching of energy sources were needed. Similarly, Cebesoy and Karışan (2017) examined pre-service teachers' knowledge and attitudes toward renewable energy sources and their self-efficacy perceptions of teaching the subject. Their knowledge level of renewable energy sources was lacking, and their attitudes were influenced by various variables. Self-efficacy perceptions were low because of their lack of knowledge and inability to practice the subject.

In addition to these studies, there are also studies on renewable energy resources that are interpreted in terms of gender variable. For example, Zyadin et al., (2014) stated that male teachers exhibit slightly higher knowledge than female teachers. Another result of the study is that female teachers hold stronger attitudes toward renewable energy than male teachers. Similarly, Liarakou, et al., (2009) stated that men were more likely to know geothermal energy as RES than women. Moreover, men were more likely to know that Photovoltaic (PV) panels transform solar energy into electricity. Men were more likely to prefer nuclear power as a future energy source than women. Women were more likely to express annoyance due to wind turbines' noise. Men were more likely to install PV panels in their houses than women.

Increasing the use of renewable energy sources will reduce dependency on fossil fuels and reduce the cost of renewable energy sources. Awareness of new developments can be enhanced through the training of professionals, who will then develop the systems and tools to be used in the future (Jennings, 2009). Social awareness is necessary if we are to have clean areas and sustainable and environmentally friendly energy sources in the future. Attitude, perception, awareness, and knowledge are increasing, and it is very important to determine and reveal the relationship among these variables. Education, from primary school to university, can play an essential part in all these respects. Therefore, renewable energy sources should be seen as an important part of education and the teaching of this subject should be done very carefully. For this reason, this study is important in terms of determining the perceptions of the pre-service primary teachers and pre-service science teachers about renewable energy sources and providing support for correcting their negative perceptions, if any.

1.3. Research Objectives

To leave a habitable world for future generations, it is vital to raise conscious and sensitive individuals who are aware of the importance of environmentally friendly renewable energy sources. This can be achieved through education, and so the topic of renewable energy sources should be given greater importance at all levels of education. Zyadin et al. (2012) emphasized that students should begin their renewable energy education as early as possible to maximize their knowledge and develop positive attitudes and perceptions.

In this study, we aimed to examine pre-service teachers' perceptions of renewable energy sources. In this context, the present study seeks answers to the following questions:

1. Do pre-service teachers' perceptions of renewable energy sources vary significantly by gender?

2. Do pre-service teachers' perceptions of renewable energy sources vary significantly depending on the program attended?

3. Do pre-service teachers' perceptions of renewable energy sources vary significantly depending on the grade level?

2. Theoretical Framework

Zyadin et al. (2014) investigated teachers' knowledge, perceptions, and attitudes about renewable energy in a survey they conducted among 260 middle school teachers in Jordan. They found that the respondents had limited knowledge of renewable energy and that they had a neutral perception of their use. However, it was observed that the teachers had a clear positive attitude towards the development of renewable energy sources. Overall, it was determined that the male teachers had a little more knowledge about renewable energy, whereas the female teachers had a more positive attitude.

Similarly, Keramitsoglou (2016) investigated the knowledge, perception, and attitudes of young people towards renewable energy sources to determine the specific educational needs of young people. Although young people are key actors in energy policy implementation, the results of the study revealed that 234 high school students were indifferent to and uninformed on the subject.

Besides, Özaslan (2020) researched the level of knowledge and awareness of university students about renewable energy sources. According to the results of the research, it was determined that the knowledge and awareness of university students about renewable energy sources are weak. At the end of the research, it was stated that there was not enough research on renewable energy sources. Similarly, Kurt (2021) investigated the views of the people living in the energy industry region and its surroundings on renewable energy resources. The study, it was also examined whether the people living in the energy industry region and its vicinity differ in their view of renewable energy according to their demographic characteristics such as gender, age, marital status, and income status. In this study, a questionnaire was administered to 165 people. As a result of the analysis, it was determined that the people living in the energy industry region and its vicinity have a positive perspective on renewable energy. According to the results of the research, "dependence on fossil fuels" was shown as the least important problem. In addition, it was determined that the participants wanted the establishment of solar energy and wind energy facilities the most. On the other hand, it was determined that they wanted the establishment of coal power plants and nuclear power plants the least.

Demirbağ and Yılmaz (2020) tried to determine the relationships between pre-service teachers' knowledge levels, risk perceptions, and intentions about renewable energy sources in their study. A total of 642 pre-service teachers studying in 3rd and 4th grades and selected with the appropriate sampling method, participated in the study. According to the results of the study, the knowledge levels of the pre-service teachers about renewable energy sources negatively predicted their risk perceptions about renewable energy sources. Illias et al. (2020) investigated secondary school students' awareness of renewable energy in a city in Malaysia.

The survey results were used to assess the perceptions of middle school students from different grades toward renewable energy. According to the results of the survey, it was determined that the grade level, the type of home the participants currently reside in, their attitude towards their home electricity bills, and their exposure to renewable energy make a significant difference in their perceptions of renewable energy. The results of this survey can be useful in determining the renewable energy subjects to be included in the curriculum at the secondary school level to improve students' perceptions of renewable energy. Similarly, Buldur et al. (2020) investigated the effects of a nature education project on middle school students' perceptions of renewable energy. Data were collected from 60 middle school students participating in the nature education project. Participants' views on renewable energy were analyzed by collecting both qualitative and quantitative data. While the findings obtained from both qualitative and quantitative data showed that the participants had positive perceptions of renewable energy before the study, a significant increase was observed in their perceptions and awareness about renewable energy during the nature education project.

Many qualitative studies measure individuals' perceptions of renewable energy (Szarka, 2004; Barry et al., 2008; Haggett, 2008; Genç, 2019). However, quantitative studies are rare. West et al. (2010) investigated the relationships between individuals' worldviews and perceptions of renewable energy. They highlighted several issues that policymakers should consider when developing strategies to encourage greater public acceptance.

Ribeiro et al. (2018) carried out a study on public perception and awareness of renewable energy. They proposed a new methodology to estimate several typical outcomes expected from an individual, based on the proximity of the predicted perceptions of and attitudes towards renewable energy, the researcher's gender, level of education, and age, and given renewable energy technology. Eymur (2017) described engineering students' perceptions about renewable energy. Eymur (2017) stated that as the course took place, the perceptions, and misconceptions of students about renewable energy changed. Hagen and Pijawka (2015) stated that Mexican citizens in North America showed the greatest support for renewable energy sources. The authors claimed that this was because Mexicans are particularly worried about climate change. As an example of this situation, Eshchanov et al. (2011) investigated the perceptions of current decision-makers about renewable energy sources in the province of Horezm, Uzbekistan. They found that the high prices of renewable energy facilities and the inability to replace traditional energy sources were less important than raising public awareness. For many years, the main issues of concern to the public were social fears such as crime, terrorism, health, and education, not energy supplies. However, the current scarcities of energy sources and increasing demand have started to raise concerns. Significant use of renewables will require a change in consumers' perceptions. This can be achieved through education. Besides, McGowan and Sauter (2005) argued that only a few studies in this field had pointed out that the term "renewable energy" was neither well understood nor well defined by the public. The depth of participants' knowledge was not considered further in previous research. The public confused the concept of renewable energy with other terms. For example, while some respondents thought it was the same as recycling, others believed it to mean the reuse of energy. Similarly, Poortinga et al. (2006) conducted a study involving 1,491 participants to explore public perceptions of nuclear energy as a future energy option in the context of climate change. It turned out that 82% of the respondents were worried or very worried about climate change/global warming. Most of them stated that one of the best ways to combat climate change was to increase the use of renewable sources, of which they had positive perceptions.

For Jäger-Waldau (2007), the biggest obstacle to the positive perception of renewable energy sources was the current economic and social system, which was based on conventional energy sources (coal, oil, and natural gas). The second problem was the high cost of sustainable solutions. As the use of energy in the world continues to increase, the development and implementation of renewable energy technology are becoming increasingly important. Professionals working in this field are needed for the transition from fossil fuels to sustainable energy sources. This requires the provision of educational

opportunities to increase awareness and knowledge and to improve perceptions (Ebersohl, 2011). Ebersohl (2011) aimed to research the knowledge and perceptions of current North Carolina State University students concerning renewable energy technologies and to enable them to learn about career opportunities in the field. He discovered that, in general, first-year students had a basic understanding of renewable energy technologies, but held several misconceptions about the role these technologies currently play on a global scale. He suggested that it was necessary to deliver additional training technologies and lessons to meet the need for trained personnel. Besides, Karasmanaki and Tsantopoulos (2019) raised the question of whether future scientists would prefer alternative energy to the extent that they would actively support renewable energies in their decision-making. To find an answer, they investigated the attitudes and perceptions of forestry students about renewable energy sources. Because forestry is closely related to environmental protection and sustainability, students were expected to take a positive view of renewable energy sources. The authors found that the students supported measures that encouraged energy transition, and they were aware of their environmental responsibilities. Also, the students felt that renewable energy facilities would have a positive impact on a region if they replaced existing lignite facilities. This allows us to conclude that these future scientists in the environmental field are likely to promote the use and development of renewable energy in their area of responsibility. The results of the study concerning the perceptions and attitudes of the young generation were both valuable and encouraging.

Energy is an important starting point for achieving the objectives of social stability, economic growth, and environmental protection, which are the three main components of sustainable development. Therefore, energy has been one of the important issues within the scope of studies on sustainable development, and the goal of meeting the energy needs of humanity without harming the economy and the environment has come to the fore. In this context, for sustainable development, energy production from all primary energy sources should be carried out with high efficiency and clean technologies, fossil fuels should be utilized by using environmentally friendly new technologies, and fossil fuels should be replaced with renewable energy resources as much as possible (Öymen, 2020). Renewable energy sources and their use are closely related to sustainable development. To use these resources, individuals need to have awareness and know the importance of this issue. The efforts of countries aiming at sustainable development to discover sustainable energy sources are important (Dinçer, 2000) and it is necessary to increase the orientation towards renewable energy sources to find solutions to sustainable development and environmental problems today (Önal, 2020). To increase this orientation, more information should be given to people, awareness of people should be increased and they should be encouraged to develop positive perceptions and opinions. Teachers should be more knowledgeable and have developed perceptions and awareness of this issue to foster orientation toward renewable energy sources. For this, first of all, the perceptions of pre-service teachers towards renewable energy sources should be determined and educational content should be prepared to enhance these perceptions. For this reason, in this study, firstly, the perceptions of pre-service teachers towards renewable energy sources were investigated.

3. Method

3.1. Research Design

In this study, the survey model was used to determine pre-service teachers' perceptions of renewable energy sources. A survey study is a research approach that defines a current or past situation as it is or was. The survey model has a descriptive nature (Karasar, 2013: 108; Wiersma & Jurs, 2005: 162). Survey studies constitute a sub-area of descriptive research. This method can be used to determine and present current circumstances without disturbing the structure of the environment (Çepni, 2007). The flow diagram of the research process is given in Figure 1.

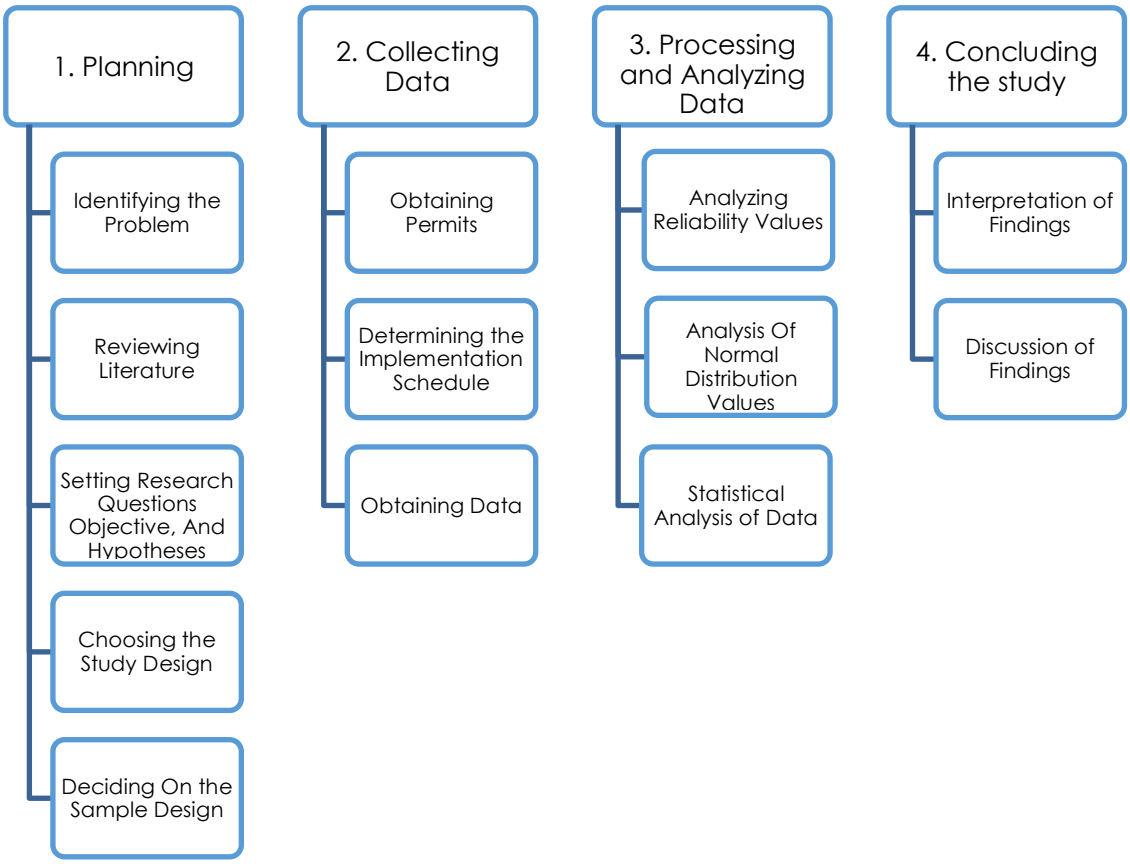

Figure 1. Flow chart describing the research process

In the planning stage, after determining the purpose of the study, the measurement tool to be used was determined. The problem statement was written following the purpose. In this stage, the study group from which the data would be collected was determined.

During the data collection stage, the study group was reached and the scale was administered. Voluntary participation of the study group was ensured. It was stated to the participants that the study would be conducted as scientific research. No personal information was received. Only grade level and gender information were requested.

The answers obtained in the analysis of the data were transferred to a program. The transferred data were analyzed using the SPSS program. In this stage, gender and grade level variables were analyzed according to the whole scale and its factors.

In the interpretation stage, the findings were evaluated and interpreted about similar studies. The findings obtained for different variables and dimensions of the scale were compared with the studies in the literature. The place of the current study in the literature was tried to be explained.

3.2. Participant

A total of 755 pre-service primary school and science teachers (1st graders, 2nd graders, 3rd graders, and 4th graders) from the Education Faculty of Düzce University. The scales completed by 15 participants were excluded from the study as they contained missing data. Table 1 presents the distribution of the pre-service teachers by grade level and gender. The participants were determined employing the convenience sampling method.

The reason for choosing pre-service primary and science teachers is that they take courses on this subject. There are "Environmental Education", "Basic Science in Primary School",

"Science Laboratory Applications", and "Science Education" in the primary teaching curriculum as required courses. In addition, there is the elective course "Sustainable Development and Education". In the science education curriculum, there are required content courses such as "Physics", "Chemistry", and "Biology" as well as pedagogy courses such as "Learning and Teaching Approaches in Science Education", "Science Curriculums", "Laboratory Applications in Science Teaching", "Teaching Science" "Scientific Reasoning Skills", "Environmental Education" "Practice Teaching in Science". In addition, there are elective courses in "Sustainable Development and Education", "Science Applications in Technology", "Problems Based on Science and Technology", "Chemical Wastes and Environmental Pollution", and "Renewable Energy Resources". In both programs, there is an elective course "Preparing Project in Education". In this course, projects are tried to be developed on renewable energy sources. Table 1 below shows the distribution of the participants by grade level and gender.

Table 1. Gender distribution of the study group across the grade levels

		Grade Level									
Program	Gender	1st Grade		2nd Grade		3rd Grade		4th Grade		Total	
		N	%	N	%	N	%	N	%	N	%
Science Teaching Program	Female	38	25	72	36	52	23,53	63	34.62	225	29.80
	Male	8	5.26	22	11	13	5.88	8	4.4	51	6.75
Primary Teaching Program	Female	80	52.63	86	43	130	58.82	97	53.30	393	52.05
	Male	26	17.10	20	10	26	11.76	14	7.69	86	11.39
Total		152	100	200	100	221	100	182	100	755	100

When Table 1 is examined, it is seen that the number of females is higher than that of males. When the grade levels are examined, it is seen that the numbers of participants from different grade levels are close to each other.

3.3. Data Collection Tools and Analysis

The Renewable Energy Perception Scale was administered to determine the pre-service teachers' perceptions of renewable energy sources. The scale was developed by Yakut-İpekoğlu et al. (2014) as a five-point Likert scale and consists of 25 items. As was noted above, it has three sub-dimensions: "Renewable Energy Knowledge", "Renewable Energy Future Vision", and "Renewable Energy Tendency". The response options in the five-point Likert scale are "Strongly Disagree", "Disagree", "Undecided", "Agree", and "Strongly Agree". The Cronbach's alpha coefficient, which is a measure of the internal consistency of the items, was used to explain or question the homogeneous structure of the items in the scale. A high Cronbach's alpha coefficient indicates that the items in the scale are consistent with each other and measure the same feature (Yıldız & Uzunsakal, 2018). The Cronbach alpha reliability coefficient of the scale in the original study was found to be 0.89 for the whole scale. The reliability value of the "Renewable Energy Knowledge" sub-dimension was found to be 0.82, that of the "Renewable Energy Future Vision" sub-dimension was found to be 0.64, and that of the "Renewable Energy Tendency" sub-dimension was found to be 0.81 (Yakut-İpekoğlu et al., 2014). Similarly, the Cronbach alpha reliability coefficient in which the scale was used was found to be 0.898 (Türkmenoğlu, 2016). In another study in which this scale was used, the pre-test reliability alpha values of the scale were calculated as 0.72 for Factor 1, 0.81 for Factor 2,

and 0.75 for Factor 3. The post-test reliability alpha values of the scale were found to be 0.72 for Factor 1, 0.75 for Factor 2, and 0.63 for Factor 3 (Buldur et al., 2020). In the current study, the Cronbach alpha reliability coefficient was calculated as .843 for the whole scale, .823 for "Renewable Energy Knowledge", .744 for "Renewable Energy Future Vision", and .724 for "Renewable Energy Tendency" sub-dimensions. The reliability of the scale is accepted as good if the coefficient is found equal to or greater than 0.70 (Kılıç, 2016; Yıldız & Uzunsakal, 2018). While the original scale was developed by applying it to 85 students, the scale was applied to 755 participants in this study. Therefore, the Cronbach alpha coefficient of the scale was higher than that of the original scale.

The "Renewable Energy Knowledge" sub-dimension consists of 16 items in total. In addition to the statements on how energy sources such as solar energy, wind turbines, geothermal energy, biodiesel, bioethanol, hydroelectric, and wave are obtained and what they are used for, some items question the effects of systems using renewable energy sources on the environment, people, plants and animals. For the second dimension, "renewable energy future predictions," inquiries were made about what might change concerning energy sources in our country and our world in the future. The participants' expectations and predictions for the continuation of the use of old energy sources and the growth in the use of renewable energy sources were investigated. For the "Renewable Energy Tendency" sub-dimension, the aim was to determine whether the participants would prefer renewable energy sources if they had the authority to do so, and correspondingly, how they would act in line with their current perception of renewable energy in the future. Sample items of the Renewable Energy Perception Scale are given in Table 2 below.

Table 2. Sample Items Included in the Scale

Factor	Item Number	Items
Renewable Energy Knowledge	5	Geothermal energy is generated from the internal heat of the earth.
	6	Bioenergy is obtained from plant biomass.
Renewable Energy Future Vision	17	In the future, renewable energy sources will be preferred.
	18	In the future, organic waste will be processed to produce energy.
Renewable Energy Tendency	24	Renewable energy sources will eventually replace traditional energy sources in homes.
	25	In the future, I can accept to pay more money to use clean energy in my house.

Table 2 shows sample items of the scale. Two scale items from each sub-dimension are given as examples.

4. Findings

In this section, the findings obtained from the "Renewable Energy Perception Scale" are presented with the research questions. Before starting the analysis of the study, Kolmogorov Smirnov test results were examined for all the sub-dimensions to see whether the items showed normal distribution or not. For the normality assumption, the significance level was taken as 0.01. Since the sample size is greater than 35, the Kolmogorov-Smirnov test was preferred. In addition, in the normality test for the scale, Kurtosis and Skewness values were found to be between 0.347 and 0.819. A kurtosis value between ±1.0 is considered excellent for most psychometric purposes, but a value between ±2.0 is in many cases also acceptable,

depending on the particular application. (George & Mallery, 2012). For the analysis of the data, SPSS for Windows 21.0 program was used.

4.1. Findings regarding the first research question

Table 3 shows whether gender is a factor significantly affecting the pre-service teachers' perceptions of renewable energy sources.

Table 3. Gender-based comparison of perceptions of renewable energy sources

Sub-dimensions	Groups	N	X	S	df	t	p
Renewable Energy Knowledge	Male	137	62.71	8.976	753	1.014	.311
	Female	618	61.92	8.091			
Renewable Energy Future Vision	Male	137	18.17	2.825	753	3.154	.002*
	Female	618	17.45	2.303			
Renewable Energy Tendency	Male	137	15.33	3.158	753	1.012	.312
	Female	618	15.59	2.622			
Total	Male	137	96.20	12.465	753	1.193	.233
	Female	618	94.96	10.730			

*p< .05

When Table 3 is examined, it is seen that there is a statistically significant difference in the perceptions of the pre-service teachers in favor of males in the "Renewable Energy Future Vision" sub-dimension. It is seen that the male participants have significantly higher scores in the "Renewable Energy Future Vision" sub-dimension compared to the female participants. However, no statistically significant gender-based differences were found in the "Renewable Energy Knowledge" or "Renewable Energy Tendency" sub-dimensions.

4.2. Findings regarding the second research question

Table 4 shows whether the pre-service teachers' perceptions of renewable energy sources vary significantly depending on the program attended.

Table 4. Comparison of the perceptions of renewable energy sources depending on the program attended

Sub-dimensions	Groups	N	X	S	df	t	p
Renewable Energy Knowledge	Science Teacher	276	61.27	7.933	753	-1.997	.046*
	Primary Teacher	479	62.52	8.414			
Renewable Energy Future Vision	Science Teacher	276	17.42	2.411	753	-1.422	.156
	Primary Teacher	479	17.68	2.422			
	Science Teacher	276	15.25	2.810	753	-2.265	.024*

Renewable Energy Tendency	Primary Teacher	479	15.71	2.666			
Total	Science Teacher	276	93.93	10.327	753	-2.362	.018*
	Primary Teacher	479	95.90	11.420			

*p< .05

When Table 4 is examined, it is seen that the pre-service primary teachers have significantly higher scores in the "Renewable Energy Knowledge" and "Renewable Energy Tendency" sub-dimensions. The pre-service primary teachers have significantly higher perception scores than the pre-service science teachers. No statistically significant difference was found in the "Renewable Energy Future Vision" sub-dimension.

4.3. Findings regarding the third research question

The arithmetic mean and standard deviation values of the perception scores of the pre-service teachers from different grade levels are given in Table 5.

Table 5. Number of the pre-service teachers in each grade level, their arithmetic means, and standard deviations

Grade	N	Z	S
First Year	152	94,43	11,07
Second Year	200	94,41	11,67
Third Year	221	96,13	11,32
Fourth Year	182	95,52	10.02

When Table 5 is examined, it is seen that as the grade level increases, the mean score increases as well. Thus, it was examined whether this difference was significant or not. The scores taken from the whole scale and its sub-dimensions by the pre-service teachers from different grade levels are given in Table 6.

Table 6. Pre-service teachers' perceptions of renewable energy sources depending on their grade levels

		Sum of Squares	df	Mean Squares	F	p	Sig.
Renewable Energy Knowledge	Between Groups	123.991	3	41.330	.605	.612	
	Within Groups	51289.206	751	68.295			
	Total	51413.197	754				
Renewable Energy Future Vision	Between Groups	17.153	3	5.718	.977	.403	
	Within Groups	4396.587	751	5.854			
	Total	4413.740	754				

Renewable Energy Tendency	Between Groups	88.605	3	29.535	4.021	.007*	2-3.grade
	Within Groups	5516.831	751	7.346			
	Total	5605.436	754				
Total	Between Groups	425.227	3	141.742	1.158	.325	
	Within Groups	91920.182	751	122.397			
	Total	92345.409	754				

*p< .05

The only significant difference was found in the "Renewable Energy Tendency" sub-dimension between 2nd and 3rd graders in favor of the 3rd graders. No significant difference was found between the grade levels in the other sub-dimensions and the whole scale. The reason for the resulting significant difference is thought to be due to the education that pre-service teachers receive in their 3rd year.

5. Discussion

The perception and knowledge level of individuals in society concerning renewable energy is the biggest obstacles to their ability to adapt to and internalize the subject. As they improve their knowledge and perception of renewable energy, individuals will be able to adopt positive attitudes and behaviors toward it, and the efficient and effective use of renewable energy sources will be possible.

The literature on perceptions of renewable energy is extensive and covers a range of countries (West et al., 2010; Eshchanov et al., 2013; Howell et al., 2012; Vaijayanthi, 2013; Zyadin et al., 2012). While some studies have evaluated perceptions as a whole, others have focused on regions that are using or are going to be using renewable energy sources. In all cases, samples of individuals have been evaluated, and inferences have been made as to how their characteristics will develop in the future. For example, a study conducted into primary teachers' perceptions of renewable energy addressed their inadequate knowledge and misconceptions (Saraç & Bedir, 2014). In addition, several studies have measured awareness of renewable energy (Karatepe et al., 2012; Çelikler, 2013). Awareness can be gained through an increase in perception and knowledge levels, but studies that examine their interactions are lacking.

That is why it is important that pre-service teachers' perceptions, of who will play an important role in the knowledge, recognition, and development of renewable energy sources, and who will help to train individuals with a commitment to sustainability are studied further.

The present study determined that there was no gender-based significant difference in the total perception scores or scores taken from the sub-dimensions. This was in line with some studies (Çelikler & Kara, 2011), but not others (Karatepe et al., 2012). Fırat et al., (2012) found that male students had more knowledge and more positive attitudes than female students. However, they concluded that students' attitudes towards renewable energy were generally positive. Karatepe et al. (2012) stated in their study of engineering students that there was no statistically significant difference between female and male pre-service teachers' attitudes towards renewable energy, but found that female students' knowledge and awareness of renewable energy were greater.

It is well known that education is an important factor in developing a positive attitude towards the recognition of renewable energy sources. Teachers and pre-service teachers who know more about renewable energy sources will help their students gain the appropriate competencies in understanding and using them (Liarakou et al., 2009). In particular, the attitude, awareness, perception, and behavior of primary and science teachers towards renewable energy sources will affect the perception, awareness, attitude, and behavior of the students they teach. In general, it has been demonstrated that environmental education (Genç, 2015) and specifically teaching and learning about renewable energy sources (Çelikler & Aksan, 2016; Çolak et al., 2015; Keramitsoglou, 2016) are important for the future.

In the present study, a statistically significant difference was observed in favor of the 3-grade pre-service teachers in the "Renewable Energy Tendency" sub-dimension. The pre-service primary teachers had higher scores than the pre-service science teachers in the "Renewable Energy Knowledge" and "Renewable Energy Tendency" sub-dimensions and whole scale. This situation can be explained by the statistically significant relationship between the critical thinking skills and emotional intelligence of pre-service primary teachers. Dutoğlu and Tuncel (2008) suggested that there is a relationship between pre-service teachers' critical thinking skills and their emotional intelligence. Accordingly, while the pre-service primary teachers approach the subject critically, they also use their emotional intelligence. On the other hand, Diken and Aydoğdu (2018) claimed there was no relationship between pre-service science teachers' emotional intelligence levels, their achievements, and their attitudes toward science. Accordingly, it can be stated that pre-service science teachers' knowledge of and attitudes toward renewable energy sources do not influence their perceptions.

Özaslan (2020) stated that university students' knowledge and awareness about renewable energy resources were weak, while Kurt (2021) found that the people living in and around the energy-specialized industrial zone had a positive perspective on renewable energy. Similarly, Demirbağ and Yılmaz (2020) in their study, in which they determined the relationships between pre-service teachers' knowledge levels, risk perceptions, and intentions regarding renewable energy sources, stated that the more the pre-service teachers' knowledge about renewable energy resources is, the lower their risk perception regarding renewable energy resources will be. On the other hand, Illias et al. (2020) researched the awareness of middle school students on renewable energy in their study and determined that grade level, the type of residence of the participants, their attitude towards their home electricity bills, and their exposure to renewable energy made a significant difference in their perception of renewable energy. Illias et al. (2020) emphasized the need to include renewable energy in secondary school curricula to improve students' perception of renewable energy. Buldur et al. (2020), in their study investigating the effects of a nature education project on middle school students' perceptions of renewable energy, determined that the nature education project has a positive contribution to the perceptions and awareness of renewable energy.

Ribeiro et al. (2018) created a model to investigate the effect of economic, environmental, and social factors on the perceptions of renewable energy. They stated that many different sociodemographic characteristics had no effect. Zyadin et al. (2012) claimed that knowledge and attitude had a positive influence on perceptions of renewable energy sources. They emphasized the importance of introducing relevant education as early as possible to promote the development of renewable energy, a necessary process if environmental problems arising from fossil fuels are to be avoided. More studies on pre-service teachers' knowledge, attitude, perception, and awareness are needed so that appropriate training can be put in place.

Buldur et al. (2020) used the same scale to investigate the effect of nature education on secondary school students' perceptions of RES. Renewable energy sources were included in the educational subjects and the situation that emerged at the end of the training was examined. According to the obtained results, it is stated that the education given in nature contributes significantly to the RE knowledge dimension of the students. Although there is a

positive development in the second factor of the scale, it is seen that there is no significant effect. In the third factor, there is a significant increase at the end of the training.

6. Conclusion

In light of a decline in fossil fuels, which are limited, and the problems they cause for the environment, new trends have started to emerge in energy consumption, energy sources, and energy independence, especially in developed countries. For this reason, the energy issue is not a concern only for politicians and experts but also for every individual living in this world (DeWaters & Powers, 2011).

Although this study focuses solely on the perception of renewable energy sources, in line with other related studies, the results of this study confirm that education and research on renewable energy sources can have significant positive effects on students' environmental awareness (Özgel et al., 2018). Knowledge, attitude, perception, and awareness can be increased through education and training. This is necessary if society is to have clean, sustainable, and environmentally friendly energy sources. Dependency on fossil fuels can then be reduced, and the cost of renewable sources can be reduced, too. For this to happen, great responsibilities should be taken by teachers who can teach the importance of renewable energy sources to future generations.

For the accomplishment of sustainable development, the energy supply must be balanced with the demand. However, this balance has not yet been achieved. In reaching these goals, teachers have a great responsibility in transferring the importance of renewable energy sources to future generations. There is a common consensus that renewable energy education should be included in schools, universities, and other academic institutions at various levels (Kandpal, & Broman, 2014; Skamp et al., 2019). Children who will be decision-makers, policymakers, and other authorities on renewable energy in the future will accept renewable energy as a way of life and will be users of these new energy technologies (Keramitsoglou, 2016). Similarly, how effective renewable energy education will be closely related to the way the education is given (Buldur et al., 2018).

Renewable energy sources, which are vital for sustainable development, are considered to be large enough to meet the world's energy demand several times when their production potential is used efficiently (Akella et al., 2009). For this reason, renewable energy has an important place in terms of meeting energy needs with domestic resources, reducing the energy dependence of countries, diversifying energy resources to ensure sustainable energy use, and minimizing the damage to the environment as a result (IEA, 2018).

Recommendation

Increasing technological products and energy demand add more importance to studies in alternative energy fields. Individuals need to receive adequate education to work on ways of increasing renewable energy sources. This study is important to reveal the perceptions of pre-service teachers about renewable energy sources, which will make a significant contribution to meeting the increasing energy need. Primary and science teachers will make a significant contribution to students who will have a say in energy in the future. Therefore, in this study, the perceptions of pre-service science and primary teachers towards renewable energy sources were investigated. This study has some limitations;

1. It is difficult to generalize the results of the study because the participants who filled out the questionnaire participated voluntarily.

2. The perceptions of pre-service teachers were tried to be determined with a selected scale.

3. The data were collected from students only from one university.

Thus, future studies should address these suggested limitations. Similar studies can be conducted on pre-service teachers from different universities and in different fields. In addition, international comparisons can be made by choosing sample groups from different countries.

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Conflict of Interest

The Author(s) declare(s) that there is no conflict of interest.

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