



Student Views About Energy Resources

Research Article

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ABSTRACT

In this study, it is aimed to obtain knowledge and thoughts of secondary school students about energy resources. For this purpose, the research group consisting of 108 students from 10th, 11th and 12th grades in many different secondary schools in Istanbul was determined by purposive sampling method. In order to determine students' views on energy resources, a measurement tool consisting of open-ended questions was applied to the volunteer participants who wanted to participate to the research. For the purpose of the study, students were asked questions about energy resources. Before the implementation, the pilot test was used to test the intelligibility of the questions. Content analysis method was used for data analysis. Frequency and percentage (%) tables were created by creating codes according to the answers of the students. In order to ensure the reliability of the study, the data were also examined by a field expert and reliability was calculated by using the reliability formula of Miles and Huberman (1994). As a result of the data obtained, it is seen that students have knowledge about energy resources and possible damages of energy resources but their knowledge is not enough.

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Introduction

Energy has been seen as the most important resource for the continuity of humanity for many centuries. Over time, the energy need of societies across the world has continued to increase. Today, most of the population lives in cities in most developed countries. This situation leads to significant levels of energy consumption in cities. The increase in energy consumption affects many areas, especially the economy, and energy security concerns such as energy sources and oil crises are one of the world's most significant problems from the past to the present (Oral and Özdemir, 2017). The use of fossil fuels such as coal, natural gas and oil

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is preferred intensively to meet the growing demand for energy (Göçük, 2015; Oral and Özdemir, 2017; Kanlı and Kaplan, 2018). As a result of the intensive preference for fossil fuels, the damage to the environment has increased, and fossil fuel sources have begun to deplete. As Kanlı and Kaplan (2018) also pointed out, the fact that fossil fuel sources have begun to deplete, and they are expensive makes it more understandable that fossil source-based production is unsustainable, and that renewable resources are important. All these situations have led to the emphasis on renewable energy sources.

Advances in technology have led to increased use of energy resources, while at the same time paving the way for more effective and efficient use of renewable resources. With the discovery of new energy sources, proper use and consumption of resources have become another issue that has gained importance. The importance of energy saving has become one of the highlights, especially in cities with high populations.

In order to achieve energy savings, it is important, first of all, that the community is informed about this issue, that the resources, the uses of resources and their effects should be known, and that the society is educated in this manner. Karagöz (2007) has stated that energy breakthroughs suitable for sustainable development will be possible in societies consisting of individuals who are educated to be environmentally conscious and environmentally responsible. Therefore, it is seen that education lies behind innovation, and energy lies behind development (Karagöz, 2007).

It is very important to draw the attention and awareness of the public, especially the young people who are growing up, in terms of the use of energy and energy resources. Energy is an interdisciplinary concept that is directly or indirectly related with many concepts in science. Moreover, energy is one of the basic concepts in elementary and secondary education curricula related to science education. The 21st century skills and their scope are discussed in many studies in the literature (Gelen, 2017; Yalçın, 2018; Orhan Göksün and Kurt, 2017). Gelen (2017) has stated in his study that the Partnership for 21st Century Learning (P21) project – a strategic education project implemented in the United States – is a practical and valuable example in the curriculum and teaching of 21st century skills. It is seen that in that project, environmental and global literacy skills, including energy literacy, which are among the main headings of the 21st century skills, are also among the skills and competencies that a person should have. Global literacy and environmental literacy, as included in Gelen's (2017) study, cover skills and competences such as the utilization of 21st century skills to understand and resolve global issues; the knowledge and understanding of the environmental conditions related to weather, climate, soil, energy and water; the understanding of the effects of society on nature such as the rate of resource consumption and population growth; and the personal and social measures to address environmental problems.

Individuals growing up need to be environmentally- and energy-literate people in order to develop sustainable environmental awareness, to be conscious about energy resources, to use resources properly, and to protect the environment. Topics such as economics and natural resources, alternative energy sources, sustainable development, energy saving, and the relationship of natural resources with the economy are included in the elementary school science (MEB, 2018a) and secondary school geography (MEB, 2018b) and chemistry (MEB, 2018c) curricula in order to develop young people's awareness of sustainable development about the society, economy and natural resources. There are not enough studies in the literature on how the teaching carried out in this direction affects students' opinions on energy sources.

Technological developments that are experienced rapidly in addition to the population growth in the world increase the need for energy sources. The use of energy resources also increases at the same rate. The increase in the use of energy resources also leads to rapid depletion of resources. Therefore, it is important to know people's knowledge and thoughts about energy sources and to raise their awareness about this issue.

Especially the knowledge and ideas of the growing generation are very important for the conscious consumption and effective use of energy resources. In this study, which was conducted in this direction, it was aimed to learn secondary school students' knowledge and thoughts about energy sources. Considering all this information and the deficiency in the literature, it is thought that this study will contribute to the field.

Method

Research Design and Sample

This research study utilized qualitative research methods. Content analysis method was used in the study. The research sample consists of 108 students (55 of female and 53 of male participants) who attended after-school university exam preparation courses and were studying at the 10th, 11th and 12th grades in many different secondary schools in Istanbul. The research sample was determined by using the purposeful sampling method. In purposeful sampling method; persons, events, objects or situations that meet certain criteria are included in the sample (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz and Demirel, 2016).

Data Collection

A measurement instrument consisting of 9 open-ended questions prepared to determine secondary school students' opinions on energy sources was administered to volunteer students who wanted to participate in the study. The data collection phase was carried out in one stage without any intervention to the students. The written answers of the students were collected with the help of open-ended questions.

In line with the purpose of the study, questions related to the following were directed to the students: the energy resources used in Turkey and in the world, the energy sources that should be preferred, the means of receiving information about energy sources, the harms of energy sources, and whether there were lessons on the subject in the school curriculum. Prior to the implementation, 3 students at the same grade levels as the ones in the sample were given the instrument, they were asked to read the questions, and the clarity of the questions was tested.

Data Analysis and Interpretation

Content analysis method was used in the analysis of data. Content analysis is a method that is often used to analyze written and visual data (Özdemir, 2010). There are four stages in content analysis that involve the processing of qualitative research data obtained from documents, data coding, identification of themes, arrangement of codes and themes, and definition and interpretation of findings (Yıldırım and Şimşek, 2018). Accordingly, a total of 108 students, each was coded in the form of S1, S2, S3, . . . S108 by the researchers. According to the students' answers, themes and codes were created, and frequency and percentage (%) tables were created.

The data were also examined by a subject matter expert to ensure the reliability of the study. Reliability was calculated using the reliability formula of Miles and Huberman (1994). Accordingly, the resulting value was 87%.

Results

Table 1 presents the first question on the open-ended questionnaire for energy resources and the students' opinions on the energy resources used in the world.

Table 1. Student Views About Energy Resources Used in the World

Grades	Code	Frequency	Percent (%)
10 th Grade	Solar Energy	38	18,54
	Wind Energy	35	17,07
	Nuclear Power	30	14,63
	Fossil Fuels	28	13,66
	Geothermal	22	10,73
	Hydropower	19	9,27
	Wave Energy	10	4,88
	Bioenergy	6	2,93
	Renewable Energy	6	2,93
	Non-renewable Energy	5	2,44
	Electrical Energy	2	0,98
	Light Energy	2	0,98
	Thermodynamics	2	0,98
11 th Grade	Wind Energy	35	19,66
	Solar Energy	31	17,42
	Nuclear Energy	25	14,04
	Fossil Fuels	22	12,36
	Geothermal	17	9,55
	Hydropower	14	7,87
	Renewable Energy	6	3,37
	Electrical Energy	6	3,37
	Wave Energy	5	2,81
	Non-renewable Energy	4	2,25
	Thermal power plant	3	1,69
	Biomass Energy	3	1,69
	Mineral Resources	2	1,12
	Boron	2	1,12
	Water Power	1	0,56
Manpower	1	0,56	
Chemical Energy	1	0,56	
12 th Grade	Fossil Fuels	39	23,78
	Solar Energy	26	15,85
	Wind Energy	25	15,24
	Nuclear Energy	19	11,59
	Geothermal	16	9,76
	Hydropower	16	9,76
	Biomass Energy	9	5,49
	Wave Energy	4	2,44
	Water Energy	3	1,83
	Hydrogen Energy	2	1,22
	Hydrostatic Energy	1	0,61
	Battery	1	0,61
	Electrical Energy	1	0,61
Thermal power plant	1	0,61	
Heat	1	0,61	

When the answers given by the students to the question “What are the energy resources used in the world?” in Table 1 were examined, it was seen that the 10th, 11th, and 12th grade students most frequently responded, “solar energy,” “wind energy,” “nuclear energy,” “fossil fuels” and “geothermal energy,” and least frequently responded, “light energy,” “water energy,” “manpower,” “battery” and “heat energy.”

The 10th grade students most frequently responded to the question in Table 1, “solar energy” (18.54%) and least frequently responded, “electrical energy” (0.98%), “light energy” (0.98%) and “thermodynamics” (0.98%). The 11th grade students most frequently responded to the 1st question, “high levels of wind energy” (19.66%), and least frequently responded, “water energy” (0.56%), “manpower” (0.56%) and “chemical energy” (0.56%). Of the 11th grade students, 1.12% answered, “boron.” This situation shows that boron that comes up as an alternative energy source in our country and in the world attracts the attention of the students. About the question on energy resources used in the world, the 12th grade students mostly gave the example of “fossil fuels” (28.78%), and they least frequently gave the examples “heat” (0.61%), “battery” (0.61%), “hydrostatic” (0.61%) and “thermal power plant” (0.61%).

Table 2 presents the students’ answers to the question “What are the energy resources used in Turkey?”

Table 2. Student Views About Energy Resources Used in Turkey

Grades	Code	Frequency	Percent (%)
10 th Grade	Solar Energy	25	23,81
	Fossil Fuels	24	21,90
	Wind Energy	22	20,95
	Hydropower	10	9,52
	Geothermal	8	7,62
	Nuclear Energy	6	5,71
	Water Power	3	2,86
	Renewable Energy	3	2,86
	Wave Energy	2	1,90
	Non-renewable Energy	1	0,95
	Other than nuclear energy	1	0,95
	Motion Energy	1	0,95
11 th Grade	Solar Energy	16	20,78
	Wind Energy	15	19,48
	Fossil Fuels	14	18,18
	Hydropower	7	9,09
	Electrical Energy	6	7,79
	Nuclear Energy	4	5,19
	Geothermal	4	5,19
	Renewable Energy	2	2,60
	Non-renewable Energy	2	2,60
	Wave Energy	2	2,60
	Mineral Resources	1	1,30
	Boron	1	1,30
	Waterpower	1	1,30
	Manpower	1	1,30
Thermal power plant	1	1,30	
12 th Grade	Fossil Fuels	30	43,48
	Solar Energy	14	20,29
	Hydroelectric	10	14,49

Wind Energy	9	13,04
Waterpower	2	2,90
Thermal power plant	1	1,45
Electrical Energy	1	1,45
Geothermal	1	1,45
Non-renewable Energy	1	1,45

When the answers given by the students to the question “What are the energy resources used in Turkey?” in Table 2 were examined, it was seen that the 10th, 11th, and 12th grade students most frequently responded, “solar energy,” “fossil fuels,” “wind energy,” “hydroelectric power plants” and “geothermal energy,” and least frequently responded, “motion energy,” and “thermal power plant.”

The 10th and 11th grade students most frequently responded, “solar energy,” (23.81% and 20.78%, respectively) to the question in Table 2. The 12th grade students most often responded, “fossil fuels,” (43.48%) to the question. The 10th grade students least frequently answered, “motion energy” (0.95%). The 11th grade students least frequently responded, “water energy” (1.30%), “manpower” (1.30%), and “thermal power plant” (1.30%), to the question. Of the 11th grade students, 1.30% answered, “boron.” This situation shows that boron mine, which is frequently highlighted in our country, attracts the attention of the students. About the question on energy resources used in Turkey, the 12th grade students least frequently responded, “geothermal” (1.45%), “electrical energy” (1.45%), and “thermal power plant” (1.45%).

Table 3 presents the students’ responses to the question “What source or sources do you think should be used in energy production?”

Table 3. Students’ Views About Sources Which Can Be Used in Energy Production

Grades	Code	Frequency	Percent (%)
10 th Grade	Solar Energy	20	25,32
	Wind Energy	18	22,78
	Energy sources that do not harm living beings and the environment	8	10,13
	Renewable energy resources	7	8,86
	Hydropower	6	7,59
	Nuclear Energy	6	7,59
	Geothermal	3	3,80
	Recyclable resources	2	2,53
	Other than nuclear energy	2	2,53
	Fossil Fuels	2	2,53
	Other than fossil fuels	1	1,27
	Electrical Energy	1	1,27
	Highly efficient energy resources	1	1,27
	Wave Energy	1	1,27
	Energy resources that do not harm the atmosphere	1	1,27
11 th Grade	Solar Energy	25	32,47
	Wind Energy	20	25,97
	Renewable energy resources should be preferred	9	11,69
	Natural Energy Resources	6	7,79
	Hydropower	3	3,90
	Geothermal	3	3,90

	Electrical Energy	2	2,60
	Nuclear Energy	2	2,60
	Energy resources that do not harm the atmosphere	1	1,30
	Recyclable resources	1	1,30
	Non-polluting sources	1	1,30
	Wave Energy	1	1,30
	Thermal power plant	1	1,30
	Waterpower	1	1,30
	Human Intelligence	1	1,30
12 th Grade	Solar Energy	16	25,81
	Wind Energy	11	17,74
	Nuclear Energy	7	11,29
	Waterpower	5	8,06
	Fossil Fuels	5	8,06
	Renewable Energy Resources	4	6,45
	Hydropower	2	3,23
	Wave Energy	2	3,23
	Geothermal	2	3,23
	Bioenergy	2	3,23
	Recyclable Resources	1	1,61
	Non-polluting sources	1	1,61
	Electrical Energy	1	1,61
	Hydrogen Energy	1	1,61
	Energy generated from waste	1	1,61
	Other than nuclear energy	1	1,61

When the answers given by the students to the question in Table 3 “What source or sources do you think should be used in energy production?” were examined, it was seen that the 10th grade, 11th grade, and 12th grade students most frequently responded, “solar energy” (25.32%, 32.47%, and 25.81%, respectively). The students mostly responded to the 3rd question, “the use of solar energy, wind energy, and renewable and nuclear energy sources that do not harm living things and the environment in energy production.”

According to Table 3, the 10th grade students least frequently responded, “wave energy” (1.27%), “fossil fuels” (1.27%), “sources that do not harm the atmosphere” (1.27%). The 11th grade students least frequently cited “sources that do not harm the atmosphere” (1.30%), “recyclable resources” (1.30%), and “sources that do not pollute the environment” (1.30%) as examples. Similarly, the 12th grade students least frequently responded, “recyclable resources” (1.61%), “energy generated from waste” (1.61%), and “non-polluting sources” (1.61%).

Table 4 presents the students’ responses to the question “What kind of energy source do you think may have a harmful effect on the environment and living things?”

Table 4. Students’ Views About Energy Sources Which May Have Harmful Effects in the Environment

Grades	Code	Frequency	Percent (%)
10 th Grade	Nuclear Energy	28	68,29
	Fossil Fuels	10	24,39
	Non-renewable energy resources	3	7,32
11 th Grade	Nuclear Energy	25	64,10

	Fossil Fuels	11	28,21
	Non-renewable energy resources	3	7,69
12 th Grade	Fossil Fuels	17	53,13
	Nuclear Energy	11	34,38
	Non-renewable energy resources	4	12,50

About the question on which energy sources may be harmful to the environment and living things in Table 4, the 10th, 11th and 12th grade students generally gave the answers “nuclear energy,” “fossil fuels” and “non-renewable energy resources.” The 10th grade (68.29%) and 11th grade students (64.1%) mostly responded, “nuclear energy.” The 12th grade students most often responded, “fossil fuels,” (53.13%). Non-renewable energy sources were preferred less frequently in all grade levels.

Table 5 presents the students’ responses to the question “What harmful effects do you think energy sources may have on the environment and living things?”

Table 5. Students’ Views About Harmful Effects of Energy Sources

Grades	Code	Frequency	Percent (%)
10 th Grade	Damage to living things	13	24,07
	Reduction in animal species/ extinction	7	12,96
	Environmental pollution	9	16,67
	Threat to life for living things	5	9,26
	Air pollution	4	7,41
	Reduction in plant species	4	7,41
	Genetic impairment	3	5,56
	Release of toxic gases	2	3,70
	Water pollution	2	3,70
	Radiation spread	2	3,70
	Depletion of the ozone layer	1	1,85
	Global warming	1	1,85
	Decrease in agricultural yield	1	1,85
11 th Grade	Environmental pollution	6	14,63
	Air pollution	6	14,63
	Damage to living spaces	5	12,20
	Damage to living things	4	9,76
	Threat to life for living things	3	7,32
	Radiation spread	3	7,32
	Degradation of the natural environment	3	7,32
	Depletion of the ozone layer	2	4,88
	Genetic impairment	2	4,88
	Release of toxic gases	2	4,88
	Global warming	1	2,44
	The extinction of living things	1	2,44
	Damage to plant species	1	2,44
Acid rains	1	2,44	
Water pollution	1	2,44	
12 th Grade	Damage to living things	8	17,78
	Environmental pollution	5	11,11
	Air pollution	4	8,89
	Global warming	4	8,89

Damage to living spaces	4	8,89
Release of toxic gases	3	6,67
Water pollution	3	6,67
Soil pollution	2	4,44
The extinction of living things	2	4,44
Genetic impairment	2	4,44
Radiation spread	2	4,44
Depletion of the ozone layer	1	2,22
Glacier melting	1	2,22
Acid rains	1	2,22
Disruption of the natural balance	1	2,22
Economic damage	1	2,22
Shortness of breath	1	2,22

About the question on “what kind of harmful effects energy sources may have on the environment” in Table 5, the 10th, 11th, and 12th grade students mostly gave the answers “damage to living things,” “environmental pollution,” and “air pollution.” The 10th grade students most frequently responded, “damage to living things” (24.07%), and least frequently responded, “decreasing agricultural yields” (1.85%), “depletion of the ozone layer” (1.85%), and “global warming” (1.85%).

The 11th grade students most frequently answered, “environmental pollution” (14.63%) and “air pollution” (14.63%) and least frequently answered, “water pollution” (2.44%), “acid rains” (2.44%) and “damage to plant species” (2.44%). The 12th grade students most frequently responded, “damage to living things” (17.78%) and “environmental pollution” (11.11%), and they least frequently responded such as, “economic damage” (2.22%), “melting glaciers” (2.22%) and “shortness of breath” (2.22%).

Table 6 presents the students’ responses to the question “What do you think are the energy source or sources of the future?”

Table 6. Energy Sources of the Future

Grades	Code	Frequency	Percent (%)
10 th Grade	Solar Energy	15	24,19
	Nuclear Energy	15	24,19
	Wind Energy	8	12,90
	Geothermal	4	6,45
	Space based energy	4	6,45
	Manpower	3	4,84
	Boron	3	4,84
	Hydropower	2	3,23
	Bioenergy	2	3,23
	Renewable Resources	1	1,61
	Hydrothermal Energy	1	1,61
	Biochemical energies	1	1,61
	Fossil Fuels	1	1,61
	Wave Energy	1	1,61
	Lunar Energy	1	1,61
11 th Grade	Solar Energy	18	31,58

	Nuclear Energy	10	17,54
	Wind Energy	10	17,54
	Renewable Energy Resources	5	8,77
	Boron	4	7,02
	Wave Energy	3	5,26
	Electrical Energy	3	5,26
	Manpower	1	1,75
	Hydropower	1	1,75
	Bioenergy	1	1,75
	Thermal power plant	1	1,75
12 th Grade	Solar Energy	14	29,17
	Wind Energy	7	14,58
	Renewable Energy Resources	4	8,33
	Nuclear Energy	4	8,33
	Electrical Energy	3	6,25
	Manpower	2	4,17
	Bioenergy	2	4,17
	Motion Energy	2	4,17
	Water Power	2	4,17
	Mind Power	2	4,17
	Boron	1	2,08
	Hydropower	1	2,08
	Thermal power plant	1	2,08
	Sound Energy	1	2,08
	Energy generated from waste	1	2,08
	Fossil Fuels	1	2,08

When the answers to the question “What do you think are the energy source or sources of the future?” in Table 6 were examined, it was concluded that the 10th, 11th and 12th grade students frequently gave the answers “solar energy,” “nuclear energy,” and “wind energy” and saw these sources as the energy sources of the future. The 10th grade students most frequently responded, “solar energy” (24.29%) and “nuclear energy” (24.19%) as the energy source of the future, and the least frequently given answers were “lunar energy” (1.61%) and “biochemical energy” (1.61%). The 11th grade students most frequently responded, “solar energy,” (31.58%) to the question, and least frequently responded, “bioenergy” (1.75%), “manpower” (1.75%), and “thermal power plant” (1.75%). The 12th grade students most frequently responded “solar energy” (29.17%), and they least frequently responded, “boron” (2.08%), “energy generated from waste” (2.08%), and “fossil fuels” (2.08%). When we examine the students’ answers, it is seen that they often prefer energy sources that do not pollute the environment and are present in nature.

Table 7 presents the students’ responses to the question “Where have you learned the information about energy sources?”

Table 7. Information Sources about Energy Sources

Grades	Code	Frequency	Percent (%)
10 th Grade	School	29	38,67
	Internet	18	24,00
	Television	10	13,33
	Newspaper, magazine, book	8	10,67
	Social circle (family, friends)	7	9,33
	Articles	3	4,00
11 th Grade	School	22	37,29
	Internet	15	25,42
	Newspaper, magazine, book	8	13,56
	Television	8	13,56
	Social circle (family, friends)	4	6,68
	Observation	2	3,39
12 th Grade	School	19	41,30
	Internet	14	30,43
	Newspaper, magazine, book	6	13,04
	Social circle (family, friends)	3	6,52
	Television (news, documentaries)	2	4,35
	Observation	2	4,35

When Table 7 was examined, it was seen that the students most often learned about energy sources from school and the Internet. The 10th, 11th and 12th grade students were informed by school and the Internet, followed by newspapers, magazines, books and television. About the question on getting information, the 10th grade students least frequently responded, "article" (4%), and the 11th and 12th grade students least frequently responded, "observation" (3.39% and 4.35%, respectively).

Table 8 presents the students' answers to the question "Do you think the school curriculum should include lessons on energy sources? Explain why."

Table 8: Students' Views About Lessons on Energy Sources

Grades	Code	Frequency	Percent (%)	
10 th Grade	Should be present to inform and raise awareness of students on this subject	20	37,74	
	It should be found because it is an issue that needs attention	8	15,09	
	Should be found to secure the future / life	6	11,32	
	Should be found	Should be present to increase general knowledge	4	7,55
	Should be present to raise awareness of energy saving	4	7,55	
	Should be available for contribution to the national economy	3	5,66	
	Should be found to learn energy acquisition methods	1	1,89	
	Should be found to protect the nature	1	1,89	
	Should not be present because the subject content is narrow	2	3,77	
	Should not be found	Should not exist because it doesn't comply with the school curriculum	2	3,77
11 th Grade	Should not exist because it is accessible from many sources	2	3,77	
	Should be found	Should be lessons to inform students about this issue	18	37,50
	Should be present to use energy correctly in the future	9	18,75	

		Should be present for generation awareness	4	8,33	
		Should be present to learn the use of resources	3	6,25	
		Should be present for the improve of the country	3	6,25	
		It should be found because it is an important issue	2	4,17	
		Should be found to learn energy acquisition methods	2	4,17	
		Should be present to be more sensitive to the environment	2	4,17	
		Should be present to increase general knowledge	1	2,08	
		Should be present to raise awareness of energy saving	1	2,08	
		Should be found to educate people who can generate solution	1	2,08	
	Should not be found	Should not be present because the subject content is narrow	1	2,08	
		Should not exist because it is accessible from many sources	1	2,08	
12 th Grade	Should be found	Should be present to inform and raise awareness of students on this subject	14	42,42	
		Should be found to secure the future / life	3	9,09	
		Should be present for people to get a profession in this field	2	6,06	
		Should be present in order to use the resources correctly.	2	6,06	
		Should be present to protect the economy necessary for the development of the country	2	6,06	
		Should be present to protect better the environment	2	6,06	
		Should be present to be more sensitive to the environment	2	6,06	
		Should be present to increase general knowledge	1	3,03	
		Should be present to increase awareness of energy savings	1	3,03	
		Should be present to learn the area of usage of resources	1	3,03	
		Should be found to educate people who can generate solution	1	3,03	
		Should not be found	Should not exist because it is accessible from many sources	2	6,06

When Table 8 was examined, it was seen the question “Do you think the school curriculum should include lessons on energy sources?” was frequently answered, “it should,” by the 10th, 11th, and 12th grade students. The most common answer given by the 10th grade students in terms of the presence of lessons was “to inform students and raise their awareness of this subject” (37.74%). The students who said “it should not” answered, “there should not be any separate lesson due to the narrow scope of the topic” (3.77%) as the reason for why it should not.

The 11th grade students most frequently responded, “there should be lessons to inform students about this issue” (37.50%). The students who said “it should not include” explained why they said so “as the fact that one could get information on the subject from many sources” (2.08%). The 12th grade students gave “informing students and raising their awareness about this subject” (42.42%) as the reason why the lessons should be included. The students who said “it should not include” showed “the information about the subject could be accessed from many sources” (6.06%) as the reason.

Table 9 presents the students’ responses to the question “How do you think would education on energy sources affect the society?”

Table 9. Students' Views About Education on Energy Sources

Grades	Code	Frequency	Percent (%)
10 th Grade	Provides information about energy sources	16	25,00
	Increases awareness of energy resources	8	12,50
	Increases general knowledge	8	12,50
	Increases the awareness of using resources efficiently	8	12,50
	Teaches the impacts of energy resources of life	5	7,81
	Provide to generate the new ideas and the solutions	4	6,25
	Affects career choice	4	6,25
	It shapes future energy usage	4	6,25
	Contributes to the country	2	3,13
	Provides persistence in mind	1	1,56
	Provides a different perspective to nature	1	1,56
	Raises awareness of the use of harmful resources	1	1,56
	Provides increase awareness towards environment	1	1,56
	Provides saving	1	1,56
11 th Grade	Raises awareness about energy resources	11	19,30
	Provides information about energy sources	9	15,79
	Provides increase awareness towards environment	7	12,28
	Provide to generate the new ideas and the solutions	5	8,77
	Increases general knowledge	4	7,02
	It shapes future energy usage	4	7,02
	Contributes to the country	4	7,02
	Teaches the impacts of energy resources of life	3	5,26
	Provides information about energy sources	3	5,26
	Provides efficient use of resources	2	3,51
	Provides saving	2	3,51
	Provides protection of nature	2	3,51
	Provides persistence in mind	1	1,75
	12 th Grade	Provides information about energy sources	11
Increases awareness of energy resources		9	19,57
Increases awareness for the future		5	10,87
Provide to generate the new ideas, projects and the solutions		4	8,70
Provides protection of nature		3	6,52
Teaches the impacts of energy resources of life		2	4,35
Teaches to use resources efficiently		2	4,35
Shapes future energy usage		2	4,35
Teaches to be economical		2	4,35
Contributes to the country		2	4,35
Provides to prefer the use of the least harmful sources of environment		2	4,35
Increases general knowledge		1	2,17
Increases to awareness toward environment		1	2,17

The answers given to the question "How do you think would education on energy resources affect the society?" were that education "provides information about energy sources" (25%) (the 10th grade students),

“raises awareness about energy sources” (19.30%) (the 11th grade students), and “provides information about energy resources” (23.91%) (the 12th grade students). In addition to these answers, the students also gave answers such as that education “increases the awareness of using resources efficiently” (10th grade, 12.5%), “teaches to be economical” (12th grade, 4.35%), “contributes to the country” (10th grade, 3.13%; 11th grade, 7.02%; 12th grade, 4.35%) and “affects career choice” (10th grade, 6.25%).

Conclusion and Discussion

The aim of this study was to learn secondary school students’ knowledge and opinions about energy sources. The focus in this study was on secondary school students’ knowledge and thoughts related to the energy resources used in Turkey and in the world, the energy sources that should be preferred, the means of receiving information about energy sources, the harms of energy sources, and whether there were lessons on the subject in the school curriculum. Codes were created through participant statements obtained through an open-ended form administered to learn secondary school students’ knowledge and thoughts about energy sources. The students’ opinions on energy sources were interpreted based on these codes. The results of the study were discussed in line with these codes, taking into account the results obtained in the studies in the relevant literature in the field.

The students most frequently responded, “solar energy,” “wind energy,” “fossil fuels” and “nuclear energy sources” as energy sources used in the world. In addition to that, the students responded, “light energy,” “wave energy,” “bioenergy,” “boron,” “thermal power plants,” “manpower” and “geothermal energy sources.” Based on the answers given in Table 1, it is observed that the students know about the energy resources commonly used in the world and are aware of resources of use that are newly becoming widespread such as boron and bioenergy. The fact that the students see manpower among energy resources can be interpreted as that human beings are fundamentally involved in the establishment and operation of energy systems and that the need for manpower from the past to the present is not diminished.

When the opinions of the students on the energy resources used in Turkey are examined, it is seen that they are aware of the vast majority of the energy resources used in Turkey. However, despite the geothermal power plants commonly available in Turkey, it is observed that the number of students who did not specify geothermal energy as an energy source is quite large ($n = 95$). On the other hand, 4 students gave the answer “tidal (wave) power plants” and 10 students gave the answer “nuclear power plants,” which shows that although they did not yet exist in our country, the students were found to have the wrong information that these types of energy were being used in our country. Although there are nearly 100 biogas (biomass) power plants in our country, no student mentioned this source in response to that question.

Answers given by most students about sources to be used in energy production were found to be the answers that defined renewable energy sources and their properties, such as recyclable energy sources and those that did not harm the atmosphere and the environment. The answer “waste energy” given by a student can be interpreted as that the student had knowledge of the fact that electrical energy can be generated from waste. Most students thought that fossil sources were widely used today, but it was more proper to prefer renewable energy sources.

About the question on which energy sources may be harmful to the environment and living things, the 10th, 11th and 12th grade students generally gave the answers “nuclear energy,” “fossil fuels” and “non-renewable energy sources.” Unlike the 10th and 11th grade students, the 12th grade students most often responded, “fossil fuels.” This situation is thought to be due to the widespread use of fossil fuel sources in our country and in the world.

When the answers given by the students to the question “What Kind of Harmful Effects Do You Think Energy Sources May Have on the Environment and Living Things,” it was seen that the students mostly gave the answers “damage to living things,” “environmental pollution,” and “air pollution.” Moreover, in addition to the harms of sources such as fossil fuels, the students also gave the following as answers: the harmful effects such as the spread of radiation from nuclear power plants, deterioration of the genetic structure of living things, and melting of glaciers. It is understood from the answers that the students have knowledge about the damages of energy sources. However, although ozone depletion, glacial melting and acid rains are some current environmental problems, they were not given as answers by most students.

The students’ answers about “what the energy sources or the sources of the future may be” were examined. The students’ answers emphasize that since the sources such as solar energy, nuclear energy and wind energy – that are widely used and continue to be used increasingly today – are renewable, they will be the energy sources of the future and will continue to be used. Moreover, a few students mentioned that wave energy, boron and fossil fuels would also be used in the future. Two students showed manpower and two students showed the power of mind as energy sources of the future. This can be interpreted as that there is always a need for manpower and mind to use resources.

When the students’ answers to the question “Where have you learned about energy sources?” were examined, it was seen that the most frequent response to the ways of acquiring knowledge at all grade levels was “school”, emphasizing the importance of energy education in the school. Courses offered in schools are important for raising students’ awareness about their energy resources. The second most frequent answer was the Internet. The Internet and mass media, which are widespread with the increasing use of technology today, play an important role in accessing information. It is very important to use instructional technologies and the Internet correctly in this field in order to raise awareness of students and society.

Based on the answers given by the students about the suggestion that there should be lessons in the school curriculum about energy sources, it is concluded that it is important to inform students about and raise their awareness of this issue, for them to learn about the correct use of resources, and have awareness of saving. For this reason, there should be lessons on energy sources. The students who said “there should not be such lessons” explained that the subject was included in other courses as a topic and could be accessed from many sources.

The students believe that education on energy resources will be positive for community awareness and enlightenment, for efficient use of resources, for development of awareness of savings, and for environmental protection.

In the findings of the study, it was observed that there was no significant difference between the grade levels in terms of the answers given. The students had sufficient knowledge of energy sources. However, they were more knowledgeable about solar, wind and geothermal energy – known energy sources – than other energy sources such as biomass and wave energy. Similarly, Cebesoy and Karisan (2017), in their study on preservice science teachers, have concluded that the preservice teachers had knowledge of solar, wind, geothermal and hydroelectric energy, which are main sources of renewable energy, but they do not have sufficient knowledge of other energy sources (wave energy and hydrogen energy). Other studies related to environment and energy literacy, such as the impacts of global climate change (Atik and Dogan, 2019) and students’ perceptions of renewable energy sources (Yildirim, Tanik-Onal and Buyuk, 2019), also indicate that students do not have sufficient information.

It was seen that the students had sufficient knowledge of the environmental impact of the consumption of fossil sources, whereas they were less knowledgeable about the harms of renewable energy sources. Studies

in the literature have stated that high school students have lack of knowledge of the subjects on renewable energy sources (Aktamış, 2011; Çoker, Çatlıoğlu and Birgin, 2010). Yıldız (2011), in his study, has found that 8th grade students are able to predict the environmental impact of fossil fuel use.

When the students' answers are examined, the importance of energy literacy and energy education emerges. Some of the students indicated that their knowledge was not sufficient, they should be more aware of the use and consumption of energy in society, and for these reasons, it was important to give separate courses about the use of energy sources.

Recommendations

Energy sources and use of resources are some of the most important issues of the future. It is very important to raise awareness of the society and to educate energy literate people. In this study, which was conducted in this context, it was observed that the students had knowledge about energy sources, but the information they had was not sufficient, and some of the students had conceptual errors about energy. Various suggestions may be offered in this direction.

Energy sources are a multidisciplinary subject and are the subjects of many courses such as geography, physics, chemistry and biology. Although these courses cover issues about energy sources, students have conceptual misunderstandings about this issue, and their knowledge is insufficient. In course curricula, the scope of topics on energy sources can be expanded and contents of the courses can be rearranged. In this way, more space can be given to the potential damage of all energy sources, especially to the environment, past events such as the Chernobyl disaster, oil crises and current environmental problems.

A separate course can be offered to students to help them gain literacy about energy sources, to raise their awareness on the subject, and to inform them about energy sources in physics, chemistry and geography courses at a more comprehensive level. The curriculum of this course should include subjects such as energy transformation, global environmental problems from past to present, energy crises, how energy is obtained from energy sources, which sources are preferred/should be preferred.

In this study, the importance of mass media has once again emerged in order to raise the awareness of students. Therefore, documentaries and informative programs about energy sources can be broadcast on television in order to inform students and raise their awareness. Websites and social media accounts, may be created where students can access uncontaminated information as well as content that attracts their attention.

Informative seminars may be given at schools on subjects such as energy sources, use of resources and savings.

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