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Full Length Research Paper

Determining energy saving behavior and energy awareness of secondary school students according to socio-demographic characteristics

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The aim of this study was to determine energy saving behavior and energy awareness of secondary school students and the effects of socio-demographic characteristics (gender, residential area and grade level) on energy saving and energy awareness. The research is a survey model with an approach that aims to describe the current status. A total of 400 6th, 7th and 8th grade students were included in the study. Of the participants, 209 were female, 191 were male. As for the distribution of the students according to grade levels, 162 students were enrolled in 6th Grade, 145 students were enrolled in 7th grade and 93 students in 8th grade. A total of 240 urban students and 160 rural students participated. "Energy Saving and Energy Awareness Scale" was used as data collection tool in the study. The scale consisted of 21 items and 4 factors. Cronbach's alpha reliability coefficient of the scale was found to be 0.80. The data was analyzed using one way MANOVA statistics technique in SPSS 11.5 version program. We observed that secondary school students had a high level of awareness about renewable energy sources and saving; however, they had a moderate level of interest in energy.

Key words: Energy saving awareness, interest in energy, energy awareness, renewable energy sources

INTRODUCTION

The gradual increase in the amount of energy used in connection with technology makes energy an ever more important issue. Nature is a source of nutrition, oxygen, water, energy and production for human beings. Taking raw material from the natural environment, humans produce nutrition and energy in a production environment. As a result of this production process, a product is obtained but a waste then enters the natural environment. While nature recycles and transforms some part of these wastes into raw material, a greater part pollutes the natural sources (Invergard, 1976). Air and environmental pollution are the most widely known types of pollution. One of the main reasons for air and environmental pollution is fossil fuels like coal, petroleum and natural gas which are used in industry and for heating purposes. Among the emissions produced as a result of burning of these fossil fuels, particularly carbon dioxide and sulfur dioxide are the leading air and environmental pollutants. These gases compound with water in the air and fall back to the earth in the form of acid rains. Acid rains damage the flora and our buildings and cause water and environmental pollution (Alpdoğan, 1996). Furthermore, since the use of fossil fuels might cause environmental pollution, energy production and consumption processes lead to destructive environmental pollution (Ayvaz, 1991). For these reasons, the consumption of energy sources causes environmental problems and retards sustainable development. Global energy consumption increases approximately by 2% annually. Population growth, economic growth and the efforts for achieving high living standards are among the factors that affect this increase in global energy consumption. By the end of the 21st century, it is inevitable that this increase will double. The decrease in

Table 1. EU-25 Energy dependancy ratio. .

	1995	2000	2001	2002	2003	2004	2010	2020	2030
Total	43.5	47.3	47.8	47.9	49.3	54.5	55	63.5	64.9
Fossil fuel	21.4	30.9	33.7	33	35.2	38.2	46.1	49.5	59
Petroleum	74.7	76.3	77.6	77.4	78.9	80.2	83.7	92.7	93.8
Natural gas	43.9	49.7	47.9	51.7	53.0	54.5	62.8	81.4	84.6

Source: "Eurostat (2007), Europe in Figures-Eurostat Yearbook (2006-2007).

energy source reserves increases energy costs as well. Therefore, yield losses should be minimized in energy production and consumption. The increase in yield losses draws attention to environmental problems. In addition, the reduction in energy reserves threatens sustainable development. There is a strong relationship between environmental effects of energy use and sustainable development. To achieve sustainability, renewable energy sources should be efficiently used and environmental pollution must be prevented. Plans should be made to minimize environmental problems emerging during energy production and consumption. These plans must develop economic and reliable use of energy sources (Selici et al., 2005).

As we know, energy cannot be destroyed. However it decreases as a result of entropy (entropy is the randomness and disorder in a system. As disorder increases in systems, entropy increases as well. In this case, entropy reduces the amount of useful energy and increases the amount of non-useful energy). For example, fossil fuels burnt for heating and lighting purposes in houses and work places increase the amount of carbon-dioxide emissions in the air (Darby, 2010). The increase in the use of this kind of energy results in global warming and environmental pollution. For example, while tropic ocean surface temperatures increased by half a degree between the years of 1949 to 1989, there was an 8% increase in melting snow in the northern hemisphere since 1983. For these reasons, energy saving and renewable energy sources are even more important today.

Energy saving

Regarding the problems arising due to the desire of the European Union and The United States of America to forward their interests through the wars for oil and to hold power in the management of oil sources, the power-hungry countries began to seek alternative energy sources and ways to develop energy saving policies (Çaha, 2008). Particularly the developed countries in Europe give great importance to energy efficiency and carry out studies in this field. For example, the natural gas crisis experienced between Russia and Ukraine in 2006 particularly concerned European Union countries and forced them to take measures for efficient energy use and energy saving. Sixth and 7th framework programs gave more attention to this subject. One of the measures taken by the European Union countries to reduce gradually increasing energy need was to require certification of each building according to the amount of energy use. Furthermore, to ensure that less energy is used for heating, ventilation, lighting and hot water in the buildings, these countries require employment of an energy manager. Table 1 indicates the European Union's energy need in the last 20 to 30 years (Eurostat, 2007).

As presented in Table 1, there is an increase towards the year 2030 in the used "energy amount" and in parallel to this in "energy dependency" ratio. The objective is to reverse this trend. Energy consumption in Europe increases by 1% annually. The increase in number of vehicles and the growing interest and desire in using electrical devices constitute the areas of greatest energy use. Energy consumption according to sectors was as follows: 29% in industry, 30% in transport and 41% in individual consumption (European Commission, 2006).

In its educational programs for energy saving, the European Union emphasizes that consumers should be informed about the environmental impacts of energy and energy saving as well. It is expected that simply changing the behavior of keeping electrical devices in stand-by mode would conserve 44 billion kWh in general in Europe. In addition emission (the amount of CO_2 released) trading, which is particularly expected to gain greater importance in the future in energy efficiency policies, began to be implemented in January of 2005 by the EU for the first time in the world. Emission trading occurred in the period of 2005 to 2007. Within the scope of this implementation, EU countries determine the amount of polluting emissions an industry can create. It is expected that enhancing the scope of this implementation will lead to an improvement particularly in energy efficiency of buildings with high energy consumption. With emission trading, the enterprises which exceed their quotas will have the right to purchase emission volume from the enterprises which do not use their quotas. There will be no change in the amount of emissions released into the atmosphere. However as a result of less carbon

release into the air, the enterprises are expected to tend to be energy efficient and save energy in order to gain income through emission trading (Çaha, 2008).

Why should energy saving be given priority? Energy saving does not refer to the restriction by turning off one of the two light bulbs or a programmed restriction but refers to saving energy that is consumed in excess and unnecessarily within the framework of needs and comfort conditions (http://www.eie.gov.tr/turkce/en_tasarrufu/konut_ulas/en_tasarruf_bina_ay.html). The European Union currently purchases approximately 50% of its energy need at a cost of around 240 billion Euros each year. If no action is taken, this need is expected to reach 70% by 2030.

Furthermore, while the energy sources in Europe decreased, energy consumption increased and renewable energy did not replace gas and petroleum as an alternative source of energy. For this reason, in green paper journal, the European Commission suggested that energy saving would be the most effective way to reduce energy need. If energy saving can be achieved, a saving of up to 20% can be achieved in 20 years. This, in turn, might provide an average family to make a saving of 200 to 1000 Euros in a year. Furthermore, reduction of energy consumption might decrease greenhouse gas effects and climate changes. Therefore, advanced technologies are in development for industrial energy saving in Europe.

The motive in energy is to achieve the most efficient use of limited energy sources and to reduce unnecessary energy consumption and losses. The goal is to perform the same work using less energy. To reduce unnecessary energy consumption and losses, humans should consume energy consciously. One of the ways of achieving this is through education. Students, families and teachers, in short, the society, should be trained for a conscientious consumption of energy. It is important to provide training to raise an awareness of energy and economic use of energy starting form primary education, which is the starting point of formal education. It is impossible or very difficult to change the habits acquired at a young age. For this reason, education can be considered as the most effective way of creating a lasting behavior change from a young age. Considering the importance of energy and saving, it is necessary to emphasize energy and saving at every school grade level.

Increasing energy need in Europe made energy saving imperative. In this context, a review of the literature revealed that there were numerous projects and studies on energy saving and efficient energy use (Mumma et al., 1966; Rowland, 1980; Sarvis, 1980; Wenig, 1981; Theiss, 1982; Crelinsen, 1983; Nicholson, 1996; Newson, 1997; Kirchhoff, 2001; Hjeresen et al., 2002; Papadouris, Constantinou and Kyratsi, 2008). In addition, to meet the increasing energy need in Europe in parallel to developing technology, renewable energy sources that importance.

Renewable energy sources

Energy and energy sources are necessary for the survival of humans on earth. For this reason, energy and energy sources have always drawn the attention of humankind for many years and have led to many wars. Attempts to find new energy sources are ongoing. Water, sun, petroleum, wind, different gases, some mines, some plants have been used as energy sources; however, in recent years reaching these sources or obtaining energy became difficult. These restrictions in the field of energy or negative human impact on the environment have led humankind to seek renewable energy sources. Today the importance given to particularly renewable energy sources has increased and studies are undertaken to perfect renewable energy sources. For example, smart house-buildings (buildings that produce their own electricity and heat themselves) projects have increased in recent years, indicating more importance given to renewable energy sources. Wind, sun, and geothermal energy sources can be considered renewable energy sources. Renewable energy sources are directly or indirectly sun-based. Sunlight and sun energy are used for heating, lighting and electrical production. In addition, renewable energy sources have many advantages:

(i) Renewable energy sources are clean energy sources. They have much less impact on nature than fossil fuels.
(ii) While other energy sources are limited, renewable energy sources are limitless.
(iii) Renewable energy sources require necessary materials and work power; as they are produced and installed in the immediate environment, they do not create energy dependency on external sources.
(iv) While the use of fossil fuels is unreliable, there is no security risk for renewable energy sources (Morgil et al., 2006).

Due to the fact that energy sources are restricted, energy saving, renewable energy sources and energy awareness issues are crucial subjects today. Individuals should acquire personal behaviors and habits at an early age. Particularly children at the primary education level have an important potential for this preparation. The role of current energy saving and energy awareness studies in children's developing positive attitudes towards energy saving and energy awareness is unknown. One of the ways of determining this role is to ask their views on these issues. Considering that a review of the literature revealed no studies on determining energy saving and energy awareness or on the investigation of the factors affecting children's awareness, and that it is in civilization's interest to acquire energy awareness, it is do not cause air and environmental pollution have gained particularly important to determine the awareness of particularly primary school students because they will be decision-making adults in the future. Furthermore, it is believed that collected feedback will have an important

Table 2. Distribution of the participants according to their genders, grade level and residential area.

Gender	n	%
Male	191	47.75
Female	209	52.25
Grade level		
6th grade	162	40.50
7th grade	145	36.25
8th grade	93	23.25
Living place		
Urban	240	60
Rural	160	40

n: the number of the participants in groups; %: the percentage of the participants in groups.

role in past and future studies and projects on energy saving and energy awareness. Feedbacks are necessary elements for effective learning (Darby, 2010). McCalley and Midden (2002) reported that as a result of feedback given to the participants, there was a positive increase in participants' energy saving behaviors.

The aim of this study was to determine energy saving and energy awareness of secondary school students and the effects of socio-demographic characteristics (gender, residential area and grade level) on energy saving and energy awareness. In line with this aim, the following sub-problems were addressed:

(1) What is the energy saving and energy awareness level of secondary school students?
(2) Do the energy saving behavior and energy awareness of secondary school students varies according to gender?
(3) Do the energy saving behavior and energy awareness of secondary school students varies according to grade levels?
(4) Do the energy saving behavior and energy awareness of secondary school students varies according to residential area?

METHODS

The research is a survey model that aims to gather data at a particular point in time with the intention of describing the nature of existing conditions, or identifying standards against which existing conditions can be compared, or determining the relationships that exist between specific events (Cohen et al., 2007: 205).

Participants

The population of the study consisted of secondary school students enrolled in schools in the Aegean region of Turkey. A sampling of the study was determined using random method among random sampling methods. In parallel to this method, the scale was applied on a total of 400 children who were enrolled in secondary school section of a randomly selected primary school in urban and a rural primary school. The distribution of the students according to their genders, academic success and departments is presented in Table 2.

Data collection tool

"Energy Saving and Energy Awareness Scale" (ESEAS) was used for data collection. ESEAS was developed by reviewing the related literature and "Renewable Energy Awareness Scale" developed to determine renewable energy awareness (Morgil et al., 2006). The scale developed for the environment and the related literature on energy saving and energy awareness were applied (Uzun and Sağlam, 2006). The researcher designed the items on the scale.

The scale is a five-point Lykert-type scale consisting of the items "I strongly agree", "I agree", "I partially agree", "I disagree" and "I strongly disagree". The scale contained a total of 54 items. The opinions of one specialist and five science teachers were taken and a pre-test was administered on three students from 6^{th}, 7^{th} and 8^{th} grades. A total of 19 faulty items were corrected. Thus, we achieved the scale's content validity. An ESEAS of 54 items was administered to a total of 457 children enrolled in secondary school. An exploratory factor analysis was made initially on the 54 items. According to the factor analysis results, the items which were observed to have a load value below 0.30 or the ones which were found to have high load value in more than one factor were excluded from the scale. Factor analysis was repeated for the remaining 21 items. The sub-factors and ESEAS were termed as follows: renewable energy sources, energy saving, interest in energy and energy awareness. Reliability coefficient of the scale was found to be 0.80 according to Cronbach's alpha reliability analysis. The highest score on the scale was 105, while the lowest score was 21. By taking into consideration the items which were contained in four dimensions, the names given to these dimensions, number of items within each dimension, Cronbach alpha reliability coefficient belonging to each dimension and sample items were given in Table 3.

Table 3. Names given to the factors related to ESEAS, number of Items, results of reliability study, and sample items.

Sub Dimensions	Number of Items	Cronbach alpha	Sample Items
Renewable energy sources	8	0.71	Renewable energy sources are also clean energy sources.
Energy saving	5	0.66	Without hesitation I warn someone who does not pay attention to energy saving.
Interest in energy	3	0.71	I read scientific articles about energy.
Energy awareness	5	0.55	We should tend to use alternative energy sources in energy consumption.

Table 4. Exploratory statistics on the levels of energy saving and energy awareness.

Energy Saving and energy awareness (Subscales)	N	Minimum	Maximum	$\overline{X}$	*SS*
Renewable energy sources	400	14	40	32.225	5.103
Energy saving	400	7	25	18.590	3.781
Interest in energy	400	3	15	9.782	3.007
Energy awareness	400	5	25	18.670	3.634

Data analysis

The statement “I strongly agree” was considered as 5 points; the statement “I agree” was considered as 4 points; the statement “I partially agree” was considered as 3 points; the statement “I disagree” was considered as 2 points; and the statement “I totally disagree” was considered as 1 point. Data was analyzed using one-way MANOVA analysis in SPSS 11.5 program.

FINDINGS AND COMMENT

Energy saving behavior and energy awareness levels of secondary school students

To determine energy saving and energy awareness level of the students, standard deviation and the means of the students from the scale were calculated using descriptive statistics. The results are presented in Table 4.

To determine the students’ energy saving behavior and awareness levels, the results have been assessed by an equal-interval scale. In this assessment, the minimum and maximum scores that one can get for each subscale were considered. Moreover, energy saving and energy awareness has been categorized equally spaced as “low level”, “moderate level” and “high level”. This categorization is displayed in Table 5

As indicated in the mean values given for each sub-factor in Table 5, it was understood that the students had a high level of awareness of renewable energy sources, energy saving and energy awareness and a moderate level of interest in energy.

The effect of gender on energy saving and energy awareness of secondary school students

Mean values of dependent variables of energy saving and energy awareness obtained in the study were compared using one-way MANOVA according to gender factor. It was found that there was a statistically significant difference among the mean scores of the students in terms of the sub-factors of ESEAS [Wilks’ Lambda (E) =0.962, F (4.395) =3.50, p<0.01]. Effect size of gender on students’ energy saving behavior and awareness was measured using partial eta square (n^2). Kittler, Menard and Phillips (2007) reported partial eta square values were small for (n^2)= 0.01; moderate for (n^2)=0.06; and great for (n^2)=0.14. In the study there was no significant difference according to gender variable. Partial eta square value of gender effect was found to be (n^2)=0.04. According to this value, the effect of gender in practice is slightly below average.

Since MANOVA F value was found to be statistically significant for the general of the dependant variable, one-variable ANOVA analyses were conducted to analyze how group averages varied according to gender in each dependent variable. The analyses are presented in Table 6.

Factor-based one-way ANOVA analysis according to gender indicated that the children’s energy saving awareness significantly varied according to gender [F(1, 398)=4.05, p<.05]; however, other sub-factors did not vary according to gender [F(1, 398)=2.23, p>.05; F(1, 398)=3.19, p>.05; F(1, 398)=1.21, p>.05]. The means of the students were analyzed to determine the advantageous group in terms of energy saving awareness. When Table 6 was analyzed, it was observed that average scores of females were higher than those of males.

Determination of students’ energy saving behavior and energy awareness according to grade levels

MANOVA results on the sub-dimension scores of ESEAS indicated that ESEAS factors of secondary school students significantly

Table 5. An equal-interval scale evaluation performed to determine energy saving behavior and energy awareness levels of the students.

Subscales	Score intervals		
	Lower level	Middle level	Higher level
Renewable energy sources	8.00-18.66	18.67-29.33	29.34-40.00
Energy saving	5.00-11.66	11.67-18.33	18.34-25.00
Interest in energy	3.00-7.00	7.01-11.00	11.01-15.00
Energy awareness	5.00-11.66	11.67-18.33	18.34-25.00

Table 6. Mean, standard deviation values and ANOVA results of energy saving and energy awareness level according to gender.

Variable	Gender	n	$\overline{X}$	SS	sd	F	p
Renewable energy sources	Female	209	32.59	4.97	1-398	2.23	0.136
	Male	191	31.83	5.23			
Energy saving	Female	209	18.95	3.66	1-398	4.05	0.045*
	Male	191	18.19	3.88			
Interest in energy	Female	209	9.53	3.01	1-398	3.19	0.075
	Male	191	10.06	2.98			
Energy awareness	Female	209	18.46	3.42	1-398	1.21	0.271

varied according to grade levels [Wilks' Lambda (Λ)= 0.951, *F*(8.788)=2.49, p>0.05]. Although the study reveals significant differences when controlling for grade levels, partial eta square value for grade effect was found to be n^2 =0.02. The effect of grade level in practice was found to be below moderate level. The students' one-way ANOVA results according to grade levels are presented in Table 7.

According to factor-based one-way ANOVA analysis results, there is a significant difference in energy saving sub-dimension [F (2.397) =6.89, p<0.01] according to grade level. There was no difference in renewable energy sources [F (2.397) =0.416, p>0.01], interest in energy [F (2.397) =1.08, p>0.01] and energy awareness [F (2.397)=1.51, p>0.01] sub-dimensions. To determine for which grade levels energy saving dimension varied, among post-hoc multiple comparison tests, Bonferroni test was made. According to Bonferroni test results, awareness among 6th grade students was higher than that of 7th and 8th grade students.

Determining the effects of residential area on energy saving behavior and energy awareness of secondary school students

Mean values of the dependent variables of energy saving and energy awareness were compared using one-way MANOVA according to the residential area factor. We found that there was a statistically significant difference among the children's mean scores according to residential area in terms of the sub-factors of ESEAS [Wilks' Lambda (E) =0.938, F(4.395)=6.51, p<0.01]. Effect size of residential area on energy saving and energy awareness was measured using partial eta square (n^2). Although there was a significant difference according to the residential area variable, partial eta square value of the effect of residential area was found to be n^2 =0.06. According to this value, residential area has a moderate effect in practice.

Since MANOVA F value was found to be statistically significant for the general of dependent variables, one-variable ANOVA analyses were performed to analyze how group averages varied in each dependent variable according to the residential area. The analyses are indicated in Table 8.

According to factor-based one-way ANOVA results according to living place, the students' awareness about renewable energy sources did not significantly vary according to their residential area [F(1.348)=3.79, p>0.05]. However, since p value was 0.05, it was found that the means according to living place were in favor of the students who live in the urban. The children's energy saving awareness significantly varied according to residential area [F (1.348)=7.80, p<0.01]. It was observed that this difference was in favor of the students who live in rural. The students' interest in energy was rated the same in urban as in the rural [F(1, 348). =1.12, p>0.05]. The children's energy awareness significantly varied according to residential area [F(1.348)=4.26, p<0.05]. The means of the students were analyzed to determine the advantageous group in terms of energy awareness. It is understood from Table 8 that mean scores of the children who were living in the urban were higher than those of their rural counterparts.

DISCUSSION, SUGGESTIONS AND CONCLUSION

The present study attempted to determine energy saving behavior and energy awareness levels and the effect of

Table 7. Descriptive statistics and ANOVA results of students' energy saving behavior and energy awareness according to grade levels.

ESEAS (sub-dimensions)	Grade level	n	$\overline{X}$	SS	sd	F	p
Renewable energy sources	6th grade	162	32.35	5.04	2-397	0.416	0.660
	7th grade	145	31.92	5.12			
	8th grade	93	32.48	5.21			
Energy saving	6th grade	162	19.43	3.62	2-397	6.892	0.001*
	7th grade	145	18.07	3.79			
	8th grade	93	17.94	3.80			
Interest in energy	6th grade	162	10.04	2.76	2-397	1.080	0.341
	7th grade	145	9.54	3.29			
	8th grade	93	9.72	2.96			
Energy awareness	6th grade	162	18.59	3.58	2-397	1.514	0.221
	7th grade	145	18.41	3.93			
	8th grade	93	19.23	3.20			

Table 8. Mean, standard deviation and ANOVA results of energy saving behavior and energy awareness levels according to residential area.

Variable	Residential area	n	$\overline{X}$	SS	sd	F	p
Renewable energy sources	Urban	240	32.63	4.96	1-398	3.79	0.052
	Rural	160	31.62	5.26			
Energy saving	Urban	240	18.16	3.81	1-398	7.80	0.005*
	Rural	160	19.23	3.66			
Interest in energy	Urban	240	9.91	3.10	1-398	1.12	0.290
	Rural	160	9.59	2.85			
Energy awareness	Urban	240	18.97	3.73	1-398	4.26	0.040*
	Rural	160	18.21	3.45			

gender, residential area and grade level on energy saving behavior and energy awareness of secondary school students.

It was found that secondary school students had a high level of awareness about renewable energy sources, energy saving and energy awareness; however, they had a moderate level of interest in energy. In general terms, it can be suggested that the students had a high level of awareness about energy and its saving.

When energy saving and energy awareness were analyzed according to gender, it was found that there was a significant difference among energy saving awareness of secondary school students according to gender and that this difference was in favor of females. It can be suggested that female students had a higher energy saving awareness than males. There might be numerous factors affecting this result. Therefore, future studies should investigate socio-demographic characteristics of the families and the effects of these characteristics on the children's awareness.

It was found that energy saving and energy awareness of secondary school students varied according to grade levels. This difference involved energy awareness. It was found that the difference among the grade levels in energy saving awareness dimension was in favor of 6th grade students. Sixth grade students had more awareness for energy saving than 7th and 8th grade students. Based on this view, it can be suggested that the secondary school learning process provides insufficient education for energy saving behavior. The children can be

made aware of energy through secondary school projects and activities. Energy saving and energy awareness should be emphasized during the courses by giving examples from daily life. Poortinga et al. (2004) concluded that education effectively altered energy use behavior in the home and reported that individuals with a higher educational level used less energy. However, the researchers concluded that the energy used in transport was positively correlated with educational level. In other words, the individuals with high educational level consume more energy for transport.

When the students' energy saving behavior and awareness were analyzed according to residential area, we found that there was a difference in energy saving and energy awareness. While the difference in the energy saving dimension was in favor of the rural students, energy awareness was in favor of the urban students. The fact that the students who live in rural are more integrated with nature and spend more time outdoors rather than in artificial environments like internet or television might have affected this result. As for energy awareness the fact that the students who live in urban receive additional help like educational courses and preparation for examinations might have affected this result.

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