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Energy Literacy: Review of Knowledge, Attitude, and Behavior of Middle School Students in the City of Orumiyeh

Somayyeh Mola[1], *Eskandar Fathi-Azar[2], Yousef Adib[3] , Abdo-Alrahman Namdar[4]

1. Ph.D. Students of Curriculum Studies, University of Tabriz, Iran
2. Professor of Educational Sciences, University of Tabriz, Iran
3. Professor of Curriculum Studies, University of Tabriz, Iran
4. Professor of Atomic and Molecular Physics, University of Tabriz, Iran

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سواد انرژی: بررسی دانش، نگرش و رفتار دانش آموزان دوره متوسطه اول در شهرستان ارومیه

سمیه مولا [۱] ، *اسکندر فتحی آذر[۲]، یوسف ادیب [۳] ، عبدالرحمن نامدار[۴]

۱. دانشجوی دکتری برنامه ریزی درسی، دانشگاه تبریز
۲. استاد گروه علوم تربیتی، دانشکده علوم تربیتی و روان شناسی، دانشگاه تبریز
۳. استاد گروه علوم تربیتی، دانشکده علوم تربیتی و روان شناسی، دانشگاه تبریز
۴. استاد گروه فیزیک اتمی و مولکولی، دانشگاه تبریز

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Abstract:

Energy literacy is essential in decisions related to energy and energy application in our daily lives, and various levels of knowledge and awareness about energy can affect on the activities and personal and social decisions. The aim of this study is investigating energy literacy of the middle school students. The research method is descriptive-survey. The study population consisted of all male and female middle school students in the city of Orumiyeh (35835). This study applied random cluster sampling. According to Morgan and Krejcie table (1970), a sample of 380 subjects (199 boys and 181 girls) were selected from among all students in Urmia city. The data collection tool is the energy literacy questionnaire provided by DeWaters, Graham and Powers (2013) that professors and experts have confirmed its validity. Cronbach's alpha established the reliability of questionnaire and obtained in the three domains of cognitive, affective and behavioral respectively, 0.71, 0.75 and 0.76. Data collected from the survey were analyzed using independent samples *t*-test, one-way analysis of variance (ANOVA) and Pearson correlation coefficient. Results of the survey questions indicated that the cognitive scores of students were lower than the affective and behavioral scores. Findings also indicate that relationship between cognitive-affective aspects and affective -behavioral aspects was positive and significant, but the relationship between the cognitive-behavioral aspects was not significant. Evaluate the performance of students based on age and gender showed that girls and boys in cognitive scores were significantly different, but there was no significant difference between genders in affect and behavior. The difference between the average scores of Seventh and eighth grades, eighth and ninth grades were significant. Eighth-grade students had better performance than seventh and eighth grades.

Keywords: Energy Literacy, Energy Education, The Middle School.

چکیده:

سواد انرژی در اتخاذ تصمیمات مربوط به انرژی و کاربرد انـرژی در زنـدگی روزمره حائز اهمیت است و سطوح مختلف دانش و آگاهی افراد درباره انرژی بر نحوه فعالیت‌ها و تصمیمات شخصی و اجتماعی تأثیرگذار می‌باشد. هدف تحقیق حاضر بررسی سواد انرژی دانش آمـوزان دوره متوسـطه اول اسـت. جامعهٔ آماری پژوهش شامل تمام دانش آموزان دختر و پسـر دوره متوسـطه اول شهرسـتان ارومیـه(۳۵۸۳۵) و شـیوه نمونـه‌گیـری بـه روش تصـادفی خوشه‌ای و طبقه‌ای است. ابزار گـردآوری داده‌هـا پرسشـنامه سـواد انـرژی دیواترز، گراهام و پاورز(۲۰۱۳) است که روایی آن را استادان و متخصصـان تأیید کرده‌اند و پایایی آن به‌وسیلهٔ آلفای کرونباخ تأیید شد و در سـه حیطـه شناختی، عاطفی و رفتاری به ترتیـب ۰/۷۱، ۰/۷۵ و ۰/۷۶ بـه دسـت آمـد. برای تحلیـل داده‌هـا از آزمـون همبسـتگی پیرسـون، t مسـتقل و تحلیـل واریانس یک‌راهه استفاده شد. نتایج مربوط به بررسی پرسش‌های پـژوهش نشان داد که سطح سواد انرژی دانش آموزان در بعد شناختی پـایین بـود ولی در ابعاد عاطفی و رفتاری عملکرد خوبی داشتند. بررسی عملکرد دانـش آموزان بر اساس جنسیت و پایه تحصیلی نشان داد که بین نمرات دختـران و پسران در بعد شناختی تفاوت معنی‌داری وجود داشت ولی در بعد عاطفی و رفتاری تفاوتی بین دختران و پسران وجـود نداشـت و تفـاوت نمـرات بـین پایه‌های تحصیلی هم نسبتاً کوچک بود.

واژه‌های کلیدی: سواد انرژی، آموزش انرژی، دوره متوسطه اول.

*Corresponding Author: e-fathiazar@tabrizu.ac.ir

1. INTRODUCTION

Sustainable development is one of the challenges of the twenty-first century and the main subject of discussion in the community of development and planning that due to integrity issues and its wide acceptance has become a most growing global debate. On sustainable development, stability is emphasized in all economic, social and environmental and it is believed that without the stability and balance in all aspects of society cannot be achieved sustainable development (Akhondi, Poorshafei, and Rashedi, 2014). Today, the reason for the gap between nations and communities is knowledge or ignorance. So the main challenge is the challenge of knowing and capable human resources and human resources are the most important, and most valuable asset and source (Glini, 2010). To achieve sustainable development, formal and informal learning to improve the awareness and to influence the behavior and performance of people is a crucial issue (Nikokar & Amiri, 2012). One of the critical aspects of sustainable development is attention to environmental problems (Rosalyn, 2002; Rodrigues et al., 2002; Segovia, 2010). The world continuously is facing with serious challenges such as climate change, the rapid decline of natural resources, repeated natural disasters, the spread of infectious diseases, loss of biodiversity, human rights violations, increased poverty, economic dependence on the continued growth of consumption and other (UNESCO, 2009). Today, energy is the world's most important and pervasive issue. Issues related to energy reduction and environmental impact of the energy has affected intensity the global and local policies, economic stability, choices and trends of consumers, health and welfare of human beings and the natural world (Yergin, 2011). The current trend of increasing energy consumption in the world has faced humankind with two major crises: first, environmental pollution caused by burning fossil fuels and momentum to end these sources. Powering is the most basic prerequisites for economic development and improve the quality of human life (Fotros &Barati, 2010). Looking at the statistics and information about energy consumption in Iran are sharp with developed countries, inefficient use of energy in our country is more than it's most important reasons is the low efficiency of energy conversion technologies and incorrect energy consumption Culture (Shana, 2014).

Energy has a significant influence on human life, economy, environment, depending on the amount of knowledge and how its production and use. According to energy education is more because of its importance in inducing knowledge, create links between the environment and society, responsible growth and to shape behavior on energy issues (Jennings, 2009; Jennings & Lund, 2001; Kandpal & Garg 1999; Liarakou et al., 2009; Zografakis et al.,2008).

The term "energy literacy", has been used to describe the knowledge of the common people and understand the issues related to the energy applied from 1970 (Matthews, 1978; Morrisey & Barrow, 1984) and has been used to describe the knowledge and positive attitudes towards energy conservation and renewable energy sources from 1980 (Lawrenz, 1988). Over time, the emphasis has changed from knowledge acquisition to the potential use of knowledge (Solomon, 1992). DeWaters and et al (2007) presented a systematic definition based on scientific literacy, technology literacy and environmental literacy that energy literacy defined as "understanding of citizenship" of energy and include cognitive domain (knowledge, understanding, and skills), affective domain (sensitivity, attitude) and behavioral skills (intentions, participation, and action) (DeWaters et al., 2007; DeWaters &Powers, 2013).

Studies related to attitude-behavior in the social sciences, primarily guided by the theory of planned behavior. The theory of planned behavior that is considered part of the explanatory theory that by Ajzen and Fishbein suggested to predict and explain the human behavior in specific areas (Ajzen & Fishbein, 1980; Ajzen, 1991). Energy literacy concept and theory of planned behavior both suggest that the action and act can be achieved by combining the knowledge, attitudes, and behavior. The theory consisted of attitudes,

subjective norms, perceived behavioral control, intention and behavior.

This theory, predicts the occurrence of a specific behavior when a person has the intention to perform the behavior. In other words, the most critical determinant of behavior is the intention. According to this theory, the intention to implement a behavior is predicted by three factors: 1) one have positive vision (emotional and rational) than to behavior (attitude), 2) one feels is under pressure to do social behavior (subjective norm), 3) person feels able to do behavior and that behavior is under his control (perceived behavioral control). As a general rule, positive attitude towards work, subjective norms, and perceived behavioral control most desirable make a person stronger intention to have behavior (Mehri et al., 2010).

Review of surveys and findings related to energy in many countries expressing low perceived knowledge and misconceptions by students and adults about the knowledge and understanding of the concepts related to renewable and nonrenewable energy sources, issues associated with the use of energy resources, energy production, storage and transmission of energy, consumption and conservation of energy (Rules, 2005; Bodzin, 2011; DeWaters & Powers, 2008; Attari et al., 2010; Holmes, 1978; Barrow & Morrisey, 1989; Holden &Barrow, 1984).

Researchers at the University of Minnesota in 2000, studies done on the energy consumption patterns of households in 1975 and 2000 examined to identify the characteristics, attitudes and behavior and energy use. Results showed that age, income level, home ownership and education were the strongest predictors of energy consumption behavior. Studies have shown that people with higher education, had a greater understanding of energy consumption and global aspects of energy consumption, and a lot of concern about the seriousness of the energy situation (DeWaters, 2011).

Rulls (2005), in a study entitled "Perception of elementary school students about fossil fuel energy" showed that elementary students have misconceptions about the source of the crude oil, coal, natural gas, production and stockpiling of gasoline and the importance of oil in the society. The study also showed that these misconceptions have continued into adulthood.

DeWaters and Powers (2008), by examining the energy literacy middle and high school students have reported that the intention and attitude values among students are not high particularly in New York. And generally, have acknowledged that there are energy issues and energy conservation and increased use of renewable resources is necessary.

Reiner (2008), during a survey in America, found that while many Americans claim that they are interested in and concerned about the environment but in fact, few of them were "aware."

DeWaters (2011), in a study, examines the energy literacy and the broader impacts of energy education among secondary students in New York. Results showed that energy literacy of students in cognitive and behavioral dimensions are relatively low and students' knowledge and skills in solving energy issues had little and students who were at risk of lesson plans, had progress and knowledge related to energy, especially in the higher grades were practical.

Herrmann-Abell and Deboer (2015), examined the perception of middle and high school students and students in the field of conversion, transmission, and energy conservation. The results showed that students' understanding of the grade to another grade was increasing and more problems of students in the field of energy conservation, and in some cases students had problems in the application of general principles in the real world. The results also showed that the misconceptions concerning the energy there were at all levels of education among the students and the mistakes were declining by promoting educational level.

Lee et al. (2015), examined the energy literacy of 2400 Taiwanese students involved in the energy education program and reported that energy literacy of students, was high and confident and with increasing grade, the energy literacy of students would be better, and some factors such as gender and

socioeconomic status students were also influential.

Fortus et al. (2015) in research, studied the role of energy curricula integration in student learning. Results showed that energy solidarity among courses related to the energy makes the development of deep understanding, transfer of learning and applying knowledge to students.

Shobeiri et al. (2016), examined the energy literacy education to operationalize environmental behavior among high school female students engaged in Maragheh. The results showed that 9.21 percent of students have the poor literacy level of energy, 9.68 percent have average energy literacy and 1.9 percent of students had good levels of energy literacy. The results also showed that there is a significant and positive relationship between the literacy energy and energy saving and environmental protection.

Abbaspoor et al. (2004), evaluated the cultural and psychological effects of short-term training courses for the general public to reduce energy consumption and environmental protection. The results showed that the degree program in the field of environmental protection and energy saving has been effective in changing the attitudes of people trained.

Rezapour Kamal Abad (2008), studied the management education of electrical energy consumption in middle school in 2006 with the aim of changing the attitudes and behavior towards energy efficiency in the schools. Results showed that energy education project had been influenced by changing the attitude and behavior of students.

Zare Shah Abadi et al. (2013), studied the effect of social and cultural factors on the pattern of energy consumption in households in Yazd. Regression analysis showed that education, international media, place of birth, religious emotion, members of the family, lifestyle, knowledge and residing in Yazd, were among variants that explained 30 percent of their changing consumption patterns.

Noorani Azad (2014), examined the relationship between energy consumption and education indicators using data from the years 1975-2010 in the economy of Iran. The results showed that the mentioned indexes have a positive impact on their electricity consumption and education plays an essential role in informing the people about energy and the environment and have a strategic role in improving energy efficiency.

Energy Literacy Advocates (2015) claim that energy literacy is the most significant potential source for facing an energy crisis. Energy literacy goals are preparing and familiarizing students with the conceptual and basic knowledge of energy resources and issues related to their application to create the ability to critically analyze and discover information to make informed decisions as future citizens. (Bodzin, Peffer & Kulo, 2012). Energy literate person is someone who:1) understands basic concepts of energy such as terminology of energy; 2) has a deep understanding of the energy usage in everyday life; 3) understanding of the environmental impact of energy production and consumption on all aspects of society; 4) is critical to require energy efficiency and develop alternatives to fossil fuel-based energy sources; 5) is aware of impact of personal decisions and activities of the international community of energy; 6) choices and decisions derivation reflects the attitudes and values regarding the development of energy resources and energy consumption (DeWaters, 2011). The middle school is the second stage of general education, and during this period, adolescents are on the verge of abstract thinking, and the breadth of his interests and desire is more and sees himself responsible to the community and wants to be effective in solving social problems (Maleki, 2007). Knowledge, values , and attitudes related to energy mainly shaped during childhood and youth. Therefore, the actions to promote energy education will help students overcome difficulties (Zografakis et al., 2008). Then, considering the importance of the middle school, abstract, Cross-cutting Energy concept and importance of energy literacy in today's world, this study seeks to measure the energy literacy of middle school students.

2. SURVEY QUESTIONS

1. How does the amount of energy literacy of students in the three domains of cognitive, affective and behavioral?
2. Is there a relationship between areas of cognitive, affective and behavioral of students' energy literacy?
3. Is there the difference in energy literacy score for students in seventh, eighth and ninth grades?
4. Is there the difference between the scores of male and female students in the three domains of cognitive, affective and behavior?

3. METHODS

Since the issue of energy literacy among middle school students is the purpose of this study, the research methodology is descriptive- survey. The study population is included all male and female middle school students(35835) in the academic year 2016-2017in city of Orumiyeh.

In the present study, was used two methods of sampling and multi-stage cluster random sample. According to Morgan and Krejcie table (1970), a sample of 380 subjects (199 boys and 181 girls) were selected from among all students in Urmia city. Then, using multi-stage cluster sampling method, among students of two educational districts of the city of Urmia randomly was selected schools. At the end, of every school were selected a few class and energy literacy questionnaire distributed among students who were willing to participate.

In the present study, to measure the energy literacy of students of energy literacy scale DeWaters, Graham and Powers (2013) were used. This scale consists of the three domains of cognitive (items1-29), affective (items 30-46) and behavioral (items 47-56). Cognitive domain is based on questions with five options, and affective and behavioral domains are set based on the five-item Likert –type scales. The original questionnaire was translated into Farsi, and some of the questions and statements were modified. To check the reliability of DeWaters and colleagues' questionnaires, opinions of professors and experts were used. DeWaters et al. (2013) reported the scale's alpha coefficient for cognitive domain, is 0.75, for affective domain, is 0.82 and behavioral domain, is 0.78. in this study, Cronbach's alpha coefficient for the three domains of cognitive, affective and behavioral respectively, obtained 0.71, 0.75 and 0.76 respectively which is right reliability tools. Statistical analyses were performed with *Statistical Package for Social Sciences* (SPSS) Statistics Version 22. Data collected from the survey were analyzed using independent samples *t*-test, one-way analysis of variance (ANOVA) and Pearson correlation analysis to understand the correlation between components and variables.

4. DATA ANALYSIS:

The total number of completed questionnaires was 380. The number of male respondents was 199, while the number of female respondents was 181. Respondents from middle schools were divided as follows: 131 from seventh grade, 126 from Eighth grade, and 123 from Ninth grade. The age of respondents was 13- 15 years.

1. What is the amount of energy literacy of students in the three domains of cognitive, affective and behavioral?

In Table 1, students energy literacy clear indicators (frequency, mean, standard deviation and variance) have been reported.

Table 1. Knowledge, affective, and behavioral performance for MS students.

Variable	Frequency	Average	maximum of score	Standard deviation	Variance
Cognitive	380	11.34	29	3.87	15
Affective	380	62.13	85	6.89	47.51
Behavioral	380	38.69	50	8.02	64.38
Total	380	112.17	164	14.2	201.75

Cognitive dimension of Energy literacy has 29 multiple-choice questions and covers the topics of energy saving (questions 17,18,19,29), forms, and conversion and energy unit (questions 2,3,4,6), energy consumption in the home (questions 21,22,23), the basic concepts of energy (questions 1,5,7,8,9,20), energy resources (questions 10,11,12,13,14,24,25), analysis of renewable energy resources (questions 15 and 16) and environmental impact (26.27 questions and 28). In Table 2, can be seen the average and percentage of students' correct and incorrect answers to cognitive issues.

According to Table 2, it seems that the average and percentage of students' correct answers in cognitive dimension is lower than average and in some issues is average performance and in other matters relatively have low performance.

2. Is there a relationship between the areas of cognitive, affective and behavioral of students' energy literacy?
The Pearson correlation coefficient was used to investigate the relationship between the dimensions of the energy literacy. Results can be seen in Table 3.

The findings suggest that of relationships between cognitive-affective aspects and affective -behavioral dimension is positive and significant, but the relationship between the cognitive-behavioral dimension is not significant.

3. Is there a difference in energy literacy score of students in seventh, eighth and ninth grades?
Descriptive statistics related to Question 3 is shown in Table 4.
Test ANOVA was used to check the significance of the difference between the scores of students' energy literacy in three grades. Due to the different scoring methods, The data were standardized and then were analyzed. Levene's test was used To meet the assumption of homogeneity of variance, and the results showed that the assumption of homogeneity of variances is not violated.

Table 2. Student responses to cognitive items

The cognitive dimension	Average	percent	
		correct answer	incorrect answer
Energy saving	1.51	37.77	62.22
forms, conversion, and energy unit	1.98	49.55	50.45
Energy consumption at home	0.99	33.03	66.96
Basic concepts of energy	2.36	39.48	60.51
Energy sources	2.51	35.85	64.14
The analysis of renewable energy sources	0.50	25.15	74.85
environmental effects	1.47	49.2	50.8

Table 3. Pearson correlation coefficient between dimensions of energy literacy

Dimension	1	2	3
Cognitive dimension	-		
affective dimension	0.27**	-	
behavioral dimension	0.02	0.45**	-

**P<0.001

Table 4. Descriptive statistics of grades energy literacy

Grade	M	SD	N
seventh grade	111.42	14	131
Eighth grade	115.10	14.16	126
Ninth grade	109.96	14.05	123
Total	112.17	14.2	380

Table 5. Results of homogeneity of variance test

Significance level	Df_2	Df_1
0.890	377	2

Table 6. ANOVA to compare energy literacy scores in grades seventh, eighth and ninth

Variable	Source changes	Sum of squares	Degrees of freedom	Mean Square	F	sig
Energy literacy	Between groups	3070.3	2	1535.1	8.315	0.000
	Within groups	69604.4	377	184.6		
	Total	72674.7	379			

Table 7. ANOVA to compare dimensions of energy literacy scores in grades seventh, eighth and ninth

Variable	Source changes	Sum of squares	Degrees of freedom	Mean Square	F	sig
Cognitive	Between groups	1301.42	2	650.71	11.18	0.000
	Within groups	21942.67	377	58.2		
	Total	23244	379			
Affective	Between groups	182.55	2	91.276	3.089	0.047
	Within groups	11138.94	377	29.54		
	Total	11321.49	379			
Behavioral	Between groups	81.614	2	40.807	0.964	0.38
	Within groups	15960.16	377	42.0335		
	Total	16041.77	379			

Table 8. T-test for independent samples to compare scores of girls and boys

Energy literacy dimensions	numbers		M	SD	Df	t	sig
Cognitive	boy	199	0.91	8.76	378	2.43	0.01
	girl	181	-1	6.53			
Affective	boy	199	0.28	5.95	378	1.07	0.28
	girl	181	-0.31	4.86			
Behavioral	boy	199	-0.46	7.08	378	-1.47	0.14
	girl	181	0.50	5.78			

As reported in Table 6, results of analysis of variance between groups is a way to evaluate the difference between each grade scores show a significant difference in the level of $P < 0.05$ in energy literacy score of three grades, there are $F(2,377)=8.315$; $P=0.001$. Effect sizes were calculated using a square of Eta 0.04. After experiencing comparisons using Tukey test showed that the difference between the average scores of the seventh with eighth grade($P=0.032$) and eighth grade with Ninth ($P=0.001$) means was significant.

Results the table above (Table 7) shows that the difference between the cognitive scores of students in three grades was significant and average cognitive scores of eighth grade had a significant difference with seventh and ninth grades. Difference between the affective scores of students was significant. Tukey test showed that the significant difference was between the average scores of the eighth and ninth grade. But the results of ANOVA to compare scores on behavioral gains were not significant.

4. Is there the difference between the scores of male and female students in the three domains of cognitive, affective and behavior?
A t-test was used to evaluate the significance of the differences between girls and boys in three dimensions Energy Literacy.
According to what is shown in Table 8, there is a significant difference between girls and boys scores on the cognitive aspects but no significant differences in affective and behavior between girls and boys.

5. DISCUSSION AND CONCLUSION

This study aims took to measure the energy literacy of middle school students. Research findings showed that the literacy level of students in the cognitive domain was low but

was relatively good in terms of affective and behavioral performance. Results are in line with the results DeWaters and Powers (2011), but not in line with the findings of Lee et al. (2015). Cognitive dimension includes topics such as scientific facts, sources of energy, and the importance of energy use in individual and collective activities, understand the impact of energy resources development and application on society and the environment and skills and ability to analyze and evaluate energy issues. Analysis of information on cognitive showed that students in some subjects such as energy use, energy resources and abilities and cognitive skills on energy issues had a poor performance that this finding is consistent with research findings by Bodzin, 2011; Boyes & Stanisstreet, 1990; DeWaters & Powers, 2008; Holden & Barrow, 1984; Lawrenz, 1983.

Students had misconceptions in some cases. For example, one of the questions about the cognitive dimension of energy measurement units was about 95.8 percent of students answered incorrectly, and only 4.2% of students answered correctly. The More noted volt as a unit of measurement and a few noted kilowatt-hours as of electrical energy. Rules study (2005) showed that students had misconceptions about the source of the oil sources, coal, natural gas, production and storage of gasoline and importance of oil in society. Reviews (Bittle et al., 2009; Manville, 2007; Shelton, 2008) have shown that consumers were misconceptions about energy sources, how to produce and use energy in their homes and communities. Study Zografakis et al. (2008) have shown that people with high energy knowledge in making decisions related to energy conscious and rational act. Solomon (1992) also stated that energy perceived by Citizens requires a basic understanding of the concepts of energy and the ability to analyze critical information for effective decision making and choices of energy. One possible explanation is that various factors effect on students' awareness and cognition about energy, such as curriculum, teaching methods, educational resources, teachers, parents, age and And the socioeconomic status of students. Schools are one of the most important sources for learning about energy. Therefore. Designing integrated curriculum, the integration of energy education in an interdisciplinary context, active teaching methods (such as project and problem based learning, inquiry-based learning techniques, experimental and Hands-on learning, and Place-based outdoor learning), practical content, the use of diverse educational resources, Providing in-service training for teachers, and parent education can help to increase the level of knowledge and cognition and reduce the student's misconceptions about energy.

Affective dimensions contain awareness and concern about global issues such as energy, values, and attitudes regarding environmental issues, development, and use of energy resources, ideas and sense of responsibility and involvement in solving problems related to energy. The performance of the students in the affective domain relatively is good but on some issues, such as approval of the actions of rigor and certainty regarding environmental issues for more than a third of students did not comment. One of the items of affective concern was in school power consumption and sense of responsibility about About off lights and computers in school that 52.6 percent of students agree, 17.9 percent are neutral, and 19.4 percent of students are opposed, and one of the students said that we do not turn off the computers and lamps because school takes our money for costs and we do try to take advantage. Results of Barrow and *Morrisey* study (1987) showed that high school students have a negative attitude towards energy issues. Similar to the findings of DeWaters and Powers (2008) in survey study indicate the intention and attitude of students were low.

The results of this study showed that the difference between the performance of boys and girls, was only on the cognitive aspects but in affective and behavioral differences were not observed. These findings are Compatible with results Chen et al. (2015). In a study by DeWaters and Powers (2011), the differences were only in the affective dimension and girls were more positive attitude than boys on energy issues. Some research findings have shown that females than males have a positive attitude towards

energy issues (Ayers, 1977; *Morrisey*& Barrow, 1987; Lawrenz & Dantchik, 1985; Lee et al., 2015). For environmental literacy, female students generally have more knowledge, a more positive attitude, and more responsible behavior than male students at the elementary school, middle school, and university levels (Alp et al., 2008; Tikka, Kuitunen& Tynys 2000; Tuncer et al., 2005).

Average of energy literacy scores of students in grade seventh, eighth and ninth grade respectively is (111.42, 115.10, 109.96), and the difference between the averages showed statistically significant differences. The average score on the cognitive aspects of eighth grade had a significant difference with seventh and ninth grades. Herrmann & Deboer (2011) studied the perception of middle and high school students and students regarding the concepts and energy conservation. The results showed that students' perception of the grade to another grade had increased. DeWaters and Powers (2011) have shown that high school students evaluate the good performance in the affective dimension compared to the middle school students. The relationship between literacy of Energy dimension showed the relationship between the affective and behavioral were higher, but no significant relationship between cognitive and affective dimension has been achieved with DeWaters and Powers (2011), and Budzin et al. (2012) are consistent. These results are inconsistent with earlier findings by Peer, Goldman,&Yavetz (2007) and Lee et al. (2015). The results of studies done on the relationship between the dimensions of energy literacy are contradictory. The results of some research findings indicate a correlation between knowledge and positive attitude towards the energy sources (Lawrenz, 1988; Valhov & Treagust, 1988). Also, check the energy literacy of high school students by Lee et al. (2015) showed that students had knowledge about energy, but they observed between affective and behavioral energy saving significant differences. Hines et al. (1986) and Bamberg & Moser (2007) do a meta-analysis on studies about the environmental behavior and found that the correlation between attitude and behavior (0.35 and 0.42, respectively) were higher than the correlation between knowledge and behavior (0.30 and 0.19, respectively). According to the research findings, it is suggested that Curriculum planners and educational policymakers use an interdisciplinary, integrated approach to design energy education and educator and teachers in schools to teach concepts and issues related to energy, more active teaching methods such as problem-based and project-based teaching and extra-curricular activities to increase students' cognitive skills must be used.

REFERENCES

Abbaspoor, M., Ahadi, H., Mahmoudi, M. & Kargari, N. (2004). “Cultural and Psychological Effects of short-term training courses for the general public to reduce energy consumption and environmental protection." *Environmental Science and Technology*, 5(4), 1-18.

Ajzen, I. (1991). “The theory of planned behavior." *Organizational Behavior and Human Decision Processes*, 50(2), 179-211.

Ajzen, I., Fishbein, M. (1980). “Understanding attitudes and predicting social behavior." Englewood Cliffs, NJ: Prentice-Hall.

Akhondi, M., Poorshafei, H. & Rashidi, F. (2014). “The role of human resources in sustainable development approach to higher education." *Proceedings of the Second Conference on Higher Education and Sustainable Development*. 84-67.

Alp, E., Ertepinar, H., Tekkaya, C. & Yilmaz, A. (2008). “ A Survey on Turkish Elementary School Students‟ Environmental Friendly Behaviours and Associated Variables." *Environmental Education Research*, 14 (2), 129–143.

Attari, S. Z., DeKay, M. L., Davidson, C. I. & Bruine de Bruin, W. (2010). “Public perceptions of energy consumption and

savings." In *Proceedings of the National Academy of Sciences,* 107(37), 16054–16059.

Ayers, J. B. (1977). " Rural elementary children's attitudes toward the energy crisis." *School Science and Mathematics*, 76(3), 238-240.

Bamberg, S. & Moser, G. (2007). "Twenty Years after Hines, Hungerford, and Tomera: A New Meta-Analysis of Psycho-Social Determinants of Pro-Environmental Behavior." *Journal of Environmental Psychology*, 27(1), 14-25.

Barrow, L. H. & Morrisey, J. T. (1987). "Ninth-grade students' attitudes toward energy: a comparison between Maine and New Brunswick." *The Journal of Environmental Education*, 18(3), 15-21.

Barrow, L. H. & Morrisey, J. T. (1989). "Energy literacy of ninth-grade students: A comparison between Maine and New Brunswick." *Journal of Environmental Education*, 20(2), 22–25.

Bittle, S., Rochkind, J. & Ott, A. (2009). "The energy learning curve: Public Agenda." Retrieved from http://www.publicagenda.org/reports/energy.

Bodzin, A. (2011). "What do eighth-grade students know about energy resources? " Paper presented at the 2011 National Association for Research in Science Teaching (NARST) Annual Meeting, Orlando.

Bodzin, A.M., Peffer, T. & Kulo, V. (2012). "The Impact of a Geospatial Technologies-Integrated Curriculum to Promote Energy Literacy." Paper presented in the 2012 Association for Science Teacher Education (ASTE) Annual Meeting in Clearwater Beach, FL.

Boyes, E. & Stanisstreet, M. (1990). "Pupils' ideas concerning energy sources." *International Journal of Science Education*, 12(5), 513–529.

Chen, S. J., Chou, Y.C., Yen, H.Y. & Chao, Y.L. (2015). "Investigating and structural modeling energy literacy of high school students in Taiwan." *Energy Efficiency*, 8(4),791–808.

DeWaters, J. E. & Powers, S. (2008). "Energy literacy among middle and high school youth." Paper presented at the 38th ASEE/IEEE Frontiers in Education Conference, Sarasota.

DeWaters, J. E. & Powers, S. (2013). "Establishing measurement criteria for an energy literacy questionnaire". *Journal of Environmental Education*, 44(1), 38-55.

DeWaters, J. E. (2011). " Energy Literacy and the Broader Impacts of Energy Education among Secondary Students in New York State." Dissertation of Ph.D., Clarkson University.

DeWaters, J. E., Powers, S. & Graham, M. (2007). "Developing an energy literacy scale. American Society for Engineering Education". *Proceedings of the 114th Annual ASEE Conference & Exposition, Honolulu*, HI.Retrievedfromhttp://www.clarkson.edu/highschool.

DeWaters, J. E., Qaqish, B., Graham, M. & Powers, S. (2013). "Designing an energy literacy questionnaire for middle and high school youth." *Journal of Environmental Education,* 44(1), 56-78.

Fortus, D., Sutherland Adams, L.M., Krajcik, J. & Reiser, B. (2015). "Assessing the Role of Curriculum Coherence in Student Learning About Energy." *Journal of Research in Science Teaching,* 52(10), 1408–1425.

Fotros, M.H; Barati, J. (2010). "Analysis of carbon dioxide emissions resulting from energy consumption to economic sectors in Iran: an analytical Shakhs.″ *Energy Economics Studies*, 28, 49-73.

Glini, M. (2010). "The role of knowledge management in enabling teachers." *Educational Technology*, 3 (26), 12-14.

Herrmann-Abell, C. F. & Deboer, G. E. (2011). "Investigating Students Understanding of Energy Transformation, Energy Transfer, and Conservation of

Energy Using Standards-Based Assessment Items." Paper presented at the 2011 NARST Annual Conference in Orlando, FL.

Herrmann-Abell, C.F. & Deboer, G. E. (2015). "Using Rasch Modeling to Explore Students‟ Understanding of Elementary School Ideas About Energy." Paper presented at the NARST Annual Conference, Chicago.

Hines, J. M., Hungerford, H. R. & Tomera, A. N. (1986). "Analysis of research on responsible environmental behavior: A meta-analysis." *Journal of Environmental Education*, 18(2), 1–8.

Holden, C. C. & Barrow, L. H. (1984). "Validation of the test of energy concepts and values for high school." *Journal of Research in Science Teaching,* 21(2), 187-196.

Holmes, B. (1978). "Energy: Knowledge and attitudes, a national assessment of energy awareness among young adults." Denver, CO: National Assessment of Educational Progress.

Jennings, P. & Lund, C. (2001). "Renewable energy education for sustainable development." *Renewable Energy*, 22(1-3), 113–118.

Jennings, P. (2009). "New directions in renewable energy education. Renewable Energy, 34(2), 435–439.

Kandpal, T. C. & Garg, H. P. (1999). "Energy education." *Applied Energy*, 64(1-4), 71–78.

Lawrenz, F. & Dantchik, A. (1985). "Attitudes toward Energy among Students in Grades 4,7 and High School". *School Science and Mathematics*, 85(3), 189–202.

Lawrenz, F. (1983). "Student Knowledge of Energy Issues." *Schoo science and mathematics*, 83(7), 587–595.

Lawrenz, F. (1988). "Prediction of student energy knowledge and attitudes." *School Science and Mathematics*, 88(7), 543–549.

Lee, L.S., Lee, K.C., Altschuld, J.W. & Pan, Y.J. (2015). " Energy literacy: Evaluating knowledge, affect, and behavior of students in Taiwan." *Energy Policy*, 76, 98–106.

Liarakou, G., Gavrilakis, C. & Flouri, E. (2009). "Secondary School Teachers‟ Knowledge and Attitudes Towards Renewable Energy Sources." *J Sci Educ Technol*, 18,120–129.

Maleki, H. (2007). "The Principles of curriculum development in Secondary education." Tehran*:* SAMT publications*.*

Manville, J. (2007). "New survey finds most Americans incorrectly believe cars and trucks consume more energy than homes." Retrieved from http://eon.businesswire.com

Matthews, W. (1978). "Practical use of energy in the home." *Journal of Consumer Studies and Home Economics*, 2, 99-118.

Mehri, A., Mazlomi, S. & Moravvati, M.A. (2010). "The effect of education on the theory of planned*." Journal of payesh*, 11(1), 13-20.

Morrisey, T.J. & Barrow, L. (1984). " A review of energy education: 1975 to NEED 1981". *Science Education*, 68(4), 365-379.

Nikokar, A. & Amiri, H. (2012). " The role of higher education in achieving sustainable development of the modern theory of development." *Proceedings of the Second Conference on Higher Education and Sustainable Development*. 124-113.

Noorani Azad, M. (2014). "The impact of education on saving energy consumption." *Proceedings of the Conference on environmental education, culture and ethics*.

Peer, S., Goldman, D. & Yavetz, B. (2007). "Literacy in Teacher Training: Attitudes, Knowledge, and Environmental Behavior of Beginning Students." *The Journal of Environmental Education*, 39 (1), 45–59.

PetroEnergy Information Network (2014), Available at: www.shana.ir

Reiner, D. M. (2008). " From public

understanding to public policy: Public views on energy, technology & climate science in the United States." Working Paper EPRG0607: Electric Policy Research Group, University of Cambridge.

Rezapour Kamalabad, H. (2008). "Management of electrical energy consumption in middle school education. 6th *National Energy* Congress.

Rodriguez, S. I., Roman, M. S., Sturhahn, S. C. (2002). " Sustainability assessment and reporting for the University of Michigan Ann Arbor Campus." A project submitted in partial fulfillment of requirements for the degree of master of science, University of Michigan.

Rosalyn, M. (2002). "Education for sustainable development toolkit version 2". Available at: www.esdtoolkit.org.

Rules, A. (2005). "Elementary students' ideas concerning fossil fuel energy." *Journal of Geoscience Education*, 53(3), 309-318.

Segovia, V. M. (2010). "Transforming mindsets through education for sustainable development**."** International encyclopedia of education pages 746-752.

Shelton, S. (2008). "Energy pulse survey shows a mix of raising awareness, confusion about energy and renewables." *Energy Efficiency*, 8,791–808

Shobeiri, S. M., Larijani M. & daught Zainaly, S. (2016). " Energy literacy education to operationalize environmental behavior." *Iranian Journal of energy*, 18(4), 133-140.

Solomon, J. (1992). Getting to know about energy: In school and society. London: The Falmer Press.

Tikka, P. M., Kuitunen, M. T. & Tynys, S. M. (2000). "Effects of Educational Background on Students‟ Attitudes, Activity Levels, and Knowledge concerning the Environment." *The Journal of Environmental Education*, 31 (3), 12–19.

Tuncer, G., Ertepinar, H. Tekkaya, C. & Sungur, S. (2005). "Environmental Attitudes of Young People in Turkey: Effects of School Type and Gender." *Environmental Education Research*, 11 (2), 215–233.

UNESCO(2009). "Review of Contexts and Structures for Education for Sustainable Development." Available at: http://www.unesco.org.

Valhov, S. J. & Treagust, D. F. (1988). "Students' knowledge of energy and attitudes toward energy conservation." *School Science and Mathematics*, 88(6), 452-458.

Yergin, D. (2011). "The Quest: Energy, security, and the remaking of the modern world." New York, NY: Penguin Press.

Zare Shah Abadi, A., Hajizadeh Meimandi, M., Lotfaliany, A. M. & Soleimani, Z. (2013). "Socio-Cultural factors affecting energy consumption patterns of households in Yazd." *Quarterly journal of energy policy and planning research*, 1(3), 17-50.

Zografakis, N., Menegaki, A. N. & Tsagarakis, K. P. (2008). "Effective education for energy efficiency.‟ *Energy Policy,* 36(8), 3226–3232.