

## Nuclear Energy Reality in Turkey and the Attitude of the Science Teachers towards the Issue

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**ABSTRACT** This research has been conducted to briefly handle the issue of nuclear power plants and the use of nuclear energy that has been occupying the agenda in Turkey in recent years and also to determine the stance of science teachers on the issue. To this end, literature review was carried out and an attitude scale was developed by the researcher in order to establish the stance of teachers on nuclear power plants and the use of nuclear energy. Validity and reliability of this scale was tested and the Cronbach alpha reliability coefficient was found to be 0.91. First off, frequency distribution given as descriptive statistics and then Kruskal-Wallis test that is among non-parametric inferential statistics for comparing the groups, and also Spearman's correlation coefficient analysis studies were conducted in the study. At the end of the study, in terms of gender, while male science teachers exhibited a positive attitude towards nuclear energy and technology, female science teachers had a negative attitude towards the issue. In terms of branches, science teachers generally demonstrated a positive stance on nuclear energy and its technology in general. A significant correlation was not found between the years science teacher have been working in the occupation and their attitude towards nuclear energy and its technology.

### INTRODUCTION

Energy is the leading condition in all countries be it developed or developing. Fast population increase and industrialization in developing countries caused the demand to energy to hike. In the event that new and large energy reserves cannot be discovered, the hypothesis that oil reserves that are among the primary energy resources would be exhausted in 2050, natural gas reserves in 2070, and coal reserves in 2170 moves the interest in energy and energy production up one notch in the globalizing world (Iskender 2011). This situation turned the limited resources used in energy production into an argument that determines and directs international policies, and also generated the need for the countries to turn to new and renewable energy production alternatives.

In the last quarter of the century, nuclear energy has become the most discussed and talked about energy type. The fast population increase in the world, quick development of industry and in parallel, excessive need to energy generated numerous problems as well. Countries turn to different energy alternatives to respond to their needs. These different energy alternatives can respond to their needs but they also bring about numerous environmental problems (Goncaloglu et al. 2000). For this reason,

countries aim to use energy alternatives in principle that would best meet their energy needs and that would not cause environmental issues.

Among the main inputs of industrial and social development of countries, energy plays an important role in increasing the life standards of the society and the provision of sustainable development. Therefore, the provision of reliable, clean, and uninterrupted energy, establishment of a market environment in which price stability would be materialized, in other words, implementing modern energy management successfully have become inevitable. Fast development in the world economy and population increase also increases the demand to energy. A major part of the increased energy demand is met by such fossil fuels as coal, oil, and natural gas. Greenhouse gas emissions generated by the use of these fuel types by human beings causes climate change, and ecologic environmental and climate changes influence deeply and permanently the safe living areas. For these reasons, maintaining both economic development and the expectations of leading a quality life within a healthy environment brings about the management of clean energy resources management. Researches and studies on sustainable and renewable energy resources that can be alternatives to fossil fuel also continue apace (Marsap and Narin 2008).

Nuclear power reactors that produce a significant amount of energy of the world meet 16% of the global electricity demand (Working Document of the NPC Global Oil and Gas Study Made Available 2007). According to reports published in the USA, radiation pollution caused by Uranium and Thorium found in the ash and smoke of coal-fired power plants as emissions is 100 times more than the radiation pollution generated by nuclear power plants that produce the same energy (US Environmental Protection Agency 1978; Gabbard 1993). Based on December 2005 data published by the International Atomic Energy Agency (IAEA), a total of 443 nuclear power plants are actively operating around the world and the installed power capacity of these nuclear power plants is 369.572 MWe (Iskender 2005; IAEA PRIS (Power Reactor Information System) 2006; IAEA PRIS (Nuclear Power Plants Information) 2006). Currently, 27 nuclear power plants are in construction. Total installed power capacity of these nuclear power plants that are being constructed is 21.811 MWe (IAEA PRIS 2006; WNA (Plans for New Reactors Worldwide) 2006).

Nuclear power plants do not emit polluting gasses into the atmosphere while they are operated. However, thermoelectric power plants that are operated by fossil fuels like coal, oil, or natural gas were established to damage the environment greatly. In order for fossil fuels to burn, oxygen is necessary. As a result of the burning process, such gasses as Carbon dioxide (CO<sub>2</sub>), Nitrous oxides (NO<sub>x</sub>), Sulphur dioxide (SO<sub>2</sub>) are generated and these are emitted through the chimneys of the power plant into the atmosphere (Atilgan 2004; TAEK 2000).

The interest of societies in world in the use of nuclear energy use has been increased by media comprehensively handling disasters especially in such nuclear power plants as Chernobyl, Three Mile Island, and Tokai, and recent leaks and explosions at Fukushima nuclear power plant occurred in the aftermath of tsunami disaster in Japan. Through the media bringing up these subjects numerous times, people are influenced by such events and may believe that nuclear power reactors have high risk of accidents, and in these cases, they may form more negative attitudes towards nuclear power plants (Ayvaci and Bakirci 2012). In fact, if an emphasis is in order within this scope, it has been highlighted that cancer cases have not been in-

creased in the Black Sea Region as a result of Chernobyl accident, that this issue is "a psychosocial event" according to a research by the Ministry of Health, that the people who are against the establishment of nuclear power plants due to a possibility of accident should bear in mind nuclear power plants in Armenia and Romania as these power plants would probably threaten our country following possible disasters (Kulebi 2007).

The nuclear power plant installed capacity around the world is expected to rise from 391 GW in 2008 to 551 GW in 2035. Until 2035, predominantly China (83 GW) and non-OECD Asian countries are estimated to have a 108 GW increase. It is believed that Russia will increase its nuclear capacity by 13 GW by 2035 through additional units. USA is also expected to reach 120 GW by 2035 by a 14 GW increase (IEA 2010; EIA 2010).

Uranium atom is an easily fissionable element. In our country, it is found in Salihli-Koprubasi and around Yozgat-Sorgun. Total natural metal uranium reserve was established as 9129 tons. Also in Eskisehir-Sivrihisar-Kizilcaoren region, worldwide-significant 380000 tons of thorium reserve is found. There also traces of thorium in Malatya-Hekimhan-Kuluncak region. 54 % of total thorium reserve in the world is found in our country (MEGEP 2007). However, Turkey has yet to move to nuclear energy and the level of knowledge on nuclear energy, its technology and equipment has not reached the desired level. The level of knowledge on the issue is quite limited on primary and secondary education schools and insufficient on bachelor and master degree levels. In fact, nuclear energy was introduced to the agenda in Turkey in 1962, however, economic and social obstacles (due to for example, objection of environmentalists and stance of governments) nuclear power plants were not established in Turkey.

In general, people have prejudices that harden them to think in a multi-directional manner and that lead them to make decisions that may not be right for them and they have the tendency to excessively trust these intuitive judgments since the acceptance of and objection to the new information structured based on their previous knowledge depend on how the approach to instinctive decision-making of individuals is. To accept or reject a situation, to demonstrate tendency to a situation or not demonstrating it,

to be for a situation or to avoid it tells the stance of the individual on that situation (Basaran 1990). The most important determinant of the attitude is the stance. Stance is emotions, thoughts, and attitudes towards an object. These three dimensions of stance are not independent of each other; they mutually affect each other, and most of the time there is a consistency among them. One of the fundamental purposes of education is to develop a social responsibility conscience in students by helping to develop educative models that attach importance to comprehend relations between science, technology, and society. In developing this responsibility conscience, family, social environment, school, and mass communication media bear significant importance (Sonmez 1994). In addition, there are factors affecting situations of decision-making on social issues about science and technology. In the process of determining these factors, personal beliefs, values and emotions play a quite important role in establishing the importance of possibilities (Tversky 1992).

This study that aims to find out the attitudes of science teachers towards the establishment of nuclear power plants and the use of nuclear energy in Turkey presumes that the infrastructure of the information a person possesses and epistemological beliefs influence the decision-making process of the individual. This presumption is based on constructivist theories of epistemology. Each individual orient themselves to social and natural environment through their ability of problem-solving they have by adding new information to the previous ones and establish their own ideas on the outer world. Comprehension is a method of arranging the new information rather than the logical presentation of information on the outer world (Can 2004). A study on the attitude of teachers that constitute the reference keystones of a society towards nuclear energy and its technology that occasionally occupy the agenda of Turkey and that has been used by developed countries around the world to generate electricity has not been found in literature. Through this study, it is believed that the viewpoint of science teachers on the issue will be discovered and a gap on this field will be filled, and also a viewpoint will be developed on environmental, healthy, and political effects of nuclear energy which occupies a significant place among energy generation alternatives.

### Objective of the Study

This study first aimed to conduct a comprehensive literature review on nuclear energy and technology in Turkey. Secondly, this study was conducted to examine the opinions of science teachers on nuclear power plants and nuclear energy that has been on the agenda of Turkey for about past fifty years thanks to mass communication means, that has been in use by developed countries in the world for electricity generation for years, and that is planned to be established within the framework of social and scientific dimensions parallel to the development of nuclear energy and technology. In this study that takes this thought as the reference point, the below-mentioned questions are sought for.

1. Analysis of the truth about nuclear energy considering Turkey
2. Establishing whether general information and attitudes of science teachers towards nuclear energy and its technology vary according to gender, branch, and occupational duration of working
3. Making necessary inferences by investigating the correlations between attitudes of science teachers towards each question on nuclear energy and its technology in accordance with gender, branch, and occupational duration of working
4. Establishing whether the source of information the science teachers have stem from lessons at school, school books, periodicals, or epistemological beliefs. Subjective beliefs of individuals on what the information is and how knowing and learning occurs are expressed as epistemological beliefs in general terms (Chen and Pajares 2010; Cheng et. al. 2009; Muis and Franco 2009; Ozkal et al. 2009; Phan 2008).

## METHODS

### Model of the Research

This research is a study in descriptive survey model conducted in order to analyze the truth about nuclear energy in terms of Turkey and also to perceive the attitudes of science teachers towards the said truth.

The sampling of the conducted research is comprised by 71 science teachers working at the entire Kutahya Science High School, Anato-

lian Teacher Training and Anatolian High Schools in Kutahya Province and its cities during the summer semester of 2010. This section contains frequency distributions of teachers included in the study according to gender, branch, and duration of working. Frequency distributions of teachers according to gender [female (1), male (2)]; branch [Physics (1), Chemistry (2), Biology (3)]; and duration of working [between (1-5) years (1), between (6-10) years (2), between (11-15) years (3), between (16-20) years (4), between (21-25) years (5)] are given in Table 1.

**Table 1: Frequency distribution of teachers according to gender, branch, and duration of working**

		Frequency	%
Gender	1.00	29	40.8
	2.00	42	59.2
	Total	71	100.0
		Frequency	%
Branch	1.00	26	36.6
	2.00	20	28.2
	3.00	25	35.2
	Total	71	100.0
	Frequency	%	
Duration of Working	2.00	11	15.5
	3.00	24	33.8
	4.00	17	23.9
	5.00	19	26.8
	Total	71	100.0

As can be seen from Table 1, 29 (40.8%) of teachers included in the study were female and 42 (59.2%) were male teachers. Of these teachers, 26 (36.6%) teaches physics, 20 (28.2%) teaches chemistry, and 25 (35.2%) teaches biology. Number of teachers with duration of working between (5-10) years were 11 (15.5%), the ones with duration of working between (11-15) years were 24 (33.8%), the ones with duration of working between (16-20) years were 17 (23.9%), and the ones with duration of working between (21-25) years were 19 (26.8%).

Data in this study were obtained through comprehensive literature review, personal fact sheets prepared for science teachers and questions within the scope of a scale developed for establishing the opinions of these teachers on nuclear power plants and nuclear energy use. While the measurement tool was being developed, printed and visual media was followed to consider different opinions during the days when constructing nuclear power plants in Turkey was being discussed intensively in addition

to a literature review. In the questionnaire, there were 4 demography questions. The participants were asked about their gender, branch, the school they teach, duration of teaching in the said section of the questionnaire. In the second section, there was five-point Likert-type scale comprised of 12 questions. The attitude expressions used in the scale were made up of 5-point scale as 'I absolutely agree' (5p), 'I agree' (4p), 'I agree on a medium level' (3p), 'I don't agree' (2p), and 'I absolutely don't agree' (1p). The lowest score that could be obtained from this scale was 12 and the highest score was 60 (Table 2).

**Table 2: Scale option and score ranges**

Options	Scores	Likert score range	Total Score ( $X_{total}$ ) Range
I absolutely agree	5	4.20-5.00	50.40-60.00
I agree	4	3.40-4.19	40.80-50.30
I agree on a medium level	3	2.60-3.39	31.20-40.70
I don't agree	2	1.80-2.59	21.60-31.10
I absolutely don't agree	1	1.00-1.79	12.00-21.50

In order to establish the validity and reliability of the prepared scale, a pre-application was conducted on 102 science teachers that were impartially chosen and that were graduates of a bachelor degree. Factor analysis was conducted in order to find out the structural validity of the scale, and expert opinions were obtained for scope validity. In the scale applied to the test group, the fact that Kaiser-Meyer-Olkin test generating a result more than 60 for twelve articles (KMO= .87) and that Bartlett's Test of Sphericity ( $p < .05$ ) obtained as significant demonstrates the suitability of scale data to factor analysis. As a result of the conducted factor analysis, 2 dimensions were created according to factor loads (Table 3). The first dimension of the test expresses the opinions of science teachers on the "establishment, efficiency, strategic importance, and future of nuclear power plants in Turkey" and the second one indicates their opinion on "the effect of nuclear power plants and weapons on environment and thus the need for seeking different energy resources". When analyzed the Table 3, it can be observed that factor loads of articles found in the first dimension were .30-.88; factor loads of articles found in the second dimension ranged between .60 and .85. In

the scale that has two factors, first factor explains 40.85% of the variance and second factor expresses 15.31% of the variance, and the total explained variance value was obtained as 56.17%. This percentage shows that the scale has measured the characteristics it aimed to measure (Buyukozturk 2008). In the analysis conducted for reliability of the scale, reliability of the scale was obtained after Cronbach alpha inner consistency coefficient was found as 91%. The developed scale was applied on teachers during an in-service training.

**Table 3: Factor loads of the test that contains the opinions of science teachers on nuclear energy and its technology**

Questions	Factor loads	
	1 <sup>st</sup> Factor	2 <sup>nd</sup> Factor
s6	.88	
s1	.87	
s7	.85	
s8	.82	
s2	.76	
s3	.72	
s9	.59	
s12	.38	
s5	.30	
s10		.85
s4		.64
s11		.60

The analyses were conducted through 12-question Likert-type questionnaire in which science teachers responded to questions on demographic characteristics and gave their opinions on nuclear power plants. Analysis of data was conducted by the researcher using SPSS Statistics Software Pack. First off, frequency distribution given as descriptive statistics and then Kruskal-Wallis test that is among non-parametric inferential statistics for comparing the groups, and also Spearman’s correlation coefficient analysis studies were conducted in the study. Cronbach  $\alpha = .05$  level of significance was taken as the basis in significance tests between the groups Analysis of correlation coefficients showing the relation between the score value of each question asked to teachers in attitude scale and their demographic characteristics was conducted and the results were interpreted. Questions

**Test Statistics (a,b)**

	q1	qs2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12
Chi-Square	6.58	8.31	9.11	5.87	4.21	13.00	10.50	11.50	3.73	.01	1.18	.20
Asymp. Sig.	.01	.00	.00	.02	.04	.00	.00	.00	.05	.94	.28	.66

4, 10, 11, and 12 that expressed negative meaning were recorded.

**FINDINGS**

A) Kruskal Wallis Test findings showing the relation between nuclear energy and attitudes according to gender of teachers and inferences from these findings are given in Table 4.

A significant difference was observed in the first eight questions expressing the attitudes of female and male science teachers towards nuclear energy and its technology based on total scores( $X_{total}$ ) ( $P < .05$ ). Attitudes of male teachers towards nuclear energy and its technology was positive compared to female teachers. The average of male teachers in questions about the dimension of the scale applied to science teachers on “*establishment, efficiency, strategic importance, and future of nuclear power plants in Turkey*” were better compared to female teachers. The reason for this may be said to stem from

**Table 4: Kruskal Wallis Test findings showing the relation between nuclear energy and attitudes according to gender of teachers**

Question	Gender	N	X(Total)
q1	1.00	29	28.67
	2.00	42	41.06
q2	1.00	29	27.90
	2.00	42	41.60
q3	1.00	29	27.55
	2.00	42	41.83
q4	1.00	29	29.10
	2.00	42	40.76
q5	1.00	29	30.41
	2.00	42	39.86
q6	1.00	29	25.83
	2.00	42	43.02
q7	1.00	29	26.81
	2.00	42	42.35
q8	1.00	29	26.43
	2.00	42	42.61
q9	1.00	29	30.52
	2.00	42	39.79
q10	1.00	29	36.21
	2.00	42	35.86
q11	1.00	29	32.93
	2.00	42	38.12
q12	1.00	29	34.74
	2.00	42	36.87

the fact that male teachers have the sufficient knowledge on nuclear energy, desire to possess nuclear energy and its technology, sensitivity to geographic-strategic position of Turkey, and belief that energy needs of countries should be met by nuclear energy and that nuclear energy would be on the hike around world again.  $X_{total(2)}=40.99$ ;  $X_{total(1)}=28.76$ . In the second dimension of the test that noted “*the effect of nuclear power plants and weapons on environment and thus the need for seeking different energy resources*”, total score of male teachers proved to be more positive compared to female teachers due to the fact that female teachers had more environmentalist approach on the issue, that they did not have sufficient knowledge and equipment on nuclear energy, and that they believed having nuclear power would bear dangerous dimensions.  $X_{total(2)}=38.24$ ;  $X_{total(1)}=32.74$ . This finding demonstrates that there was a significant relation between the attitudes towards nuclear energy and its technology and gender of teachers. However, as can be understood from the average scores of questions 10 and 12, it was quite significant that both female and male teachers expressed a common attitude in questions “I have worries about nuclear armament around the world” and “I believe the establishment of nuclear power plants in our country bears a political meaning”.

B) Kruskal-Wallis Test analysis demonstrating the relation between attitudes of teachers towards nuclear energy according to their branches, its findings and inferences are given in Table 5.

Based on the analysis results, a significant difference ( $p<.05$ ) was observed according to branches for questions (q1, q2, q3, q7, q9) on the first dimension of the test applied on science teachers that notes “*establishment, efficiency, strategic importance, and future of nuclear power plants in Turkey*”. Based on the results of Kruskal Wallis Test conducted in order to establish how differences occurred in these questions among branches, average scores-attitudes of teachers in branch 1 (Physics) compared to averages of teachers in branch

2 (Chemistry) and teachers in branch 2 compared to branch 3 (Biology) were found to be on a good level. This difference of attitudes among branches can be observed more significantly in Figure 1. Horizontal axis questions show attitude scores according to vertical axis branches.

In the first dimension questions (q5, q6, q8, q12) that did not generate significant difference, too, physics teachers demonstrated attitude average on a good level compared to chemistry teachers and chemistry teachers showed a good level compared to biology teachers. It may be

**Table 5: Kruskal-Wallis Test findings showing the relation between attitudes towards nuclear energy according to branches of teachers.**

Question	Branch	N	X(total)
q1	1.00	26	44.23
	2.00	20	35.88
	3.00	25	27.54
q2	1.00	26	42.71
	2.00	20	37.08
	3.00	25	28.16
q3	1.00	26	42.60
	2.00	20	39.15
	3.00	25	26.62
q4	1.00	26	43.25
	2.00	20	35.53
	3.00	25	28.84
q5	1.00	26	40.15
	2.00	20	32.98
	3.00	25	34.10
q6	1.00	26	40.37
	2.00	20	36.48
	3.00	25	31.08
q7	1.00	26	43.94
	2.00	20	33.60
	3.00	25	29.66
q8	1.00	26	40.98
	2.00	20	35.55
	3.00	25	31.18
q9	1.00	26	41.94
	2.00	20	38.75
	3.00	25	27.62
q10	1.00	26	40.60
	2.00	20	29.25
	3.00	25	36.62
q11	1.00	26	40.46
	2.00	20	40.05
	3.00	25	28.12
q12	1.00	26	40.81
	2.00	20	38.25
	3.00	25	29.20

**Test Statistics(a,b)**

	q1	q2	q3	q4	q5	q6	q7	q8	q9	q10	q11	q12
Chi-square	8.87	7.05	9.19	6.68	1.98	2.84	7.02	3.15	7.16	3.98	6.15	4.72
Asymp. Sig.	.01	.03	.01	.04	.37	.24	.03	.21	.03	.14	.05	.09

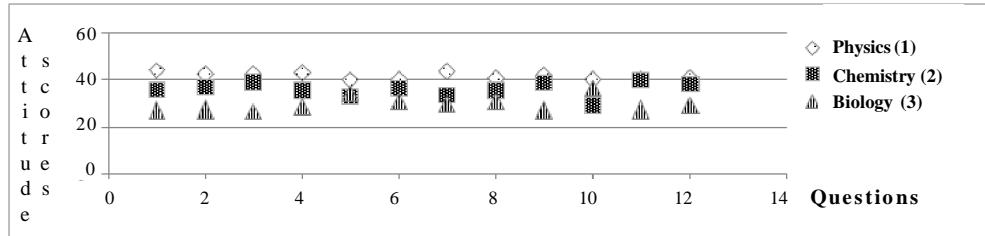


Fig. 1. Attitude averages between branches concerning nuclear energy and its technology

said in line with the comments obtained by interviews conducted with science teachers that these last two situations just expressed stem from the fact that physics teachers compared to chemistry teachers and chemistry teachers compared to biology teachers have more information on the usability and efficiency of nuclear energy and its technology due to the courses they took during their bachelor degree education. Although in the first dimension of the test science teachers exhibited positive attitudes towards nuclear energy, they expressed that the establishment of nuclear power plants bears a political meaning rather than economic and industrial development of the country in response to the twelfth question that read “I believe the establishment of nuclear power plants in our country bears a political meaning”.

In the second dimension of the test that was “the effect of nuclear power plants and weapons on environment and thus the need for seeking different energy resources”, occurrence of differentiation according to branches can be observed in q4 and q11. It can be seen that, although attitude scores of physics and chemistry teachers were high, low in q4 between each other, and so low as if non-existent in q11 in questions “I believe nuclear power plants may have effects detrimental to environment” and “Nuclear energy should be deserted and different energy alternatives should be sought”, there was a significant difference between them and biology branch. The reason may be that especially biology teachers approach the issue in environmental terms and have concerns over armament. In the tenth question asked as “I have concerns over worldwide nuclear armament”, although a significant difference was non-existent between branches, chemistry and biology teachers noted they had more concerns compared to physics teachers. In line with these assessments, due to the fact that total score of the attitudes of science teachers towards nuclear

power plant establishment and the use of nuclear energy in Turkey was  $X_{total} = 41.84$  for physics teachers,  $X_{total} = 36.05$  for chemistry teachers, and  $X_{total} = 29.90$  for biology teachers, it was observed that, on the basis of branches, physics and chemistry teachers expressed a positive attitude and biology teachers demonstrated a negative attitude towards nuclear energy and its technology due to the fact that the total attitude scores average of all the science teachers was  $X_{total} = 35.93$ , it may be noted that they demonstrated a good attitude towards nuclear energy and its technology in general terms.

C) A significant relation was not established between attitudes of science teachers towards nuclear energy and its technology based on total years they have been working in the occupation since  $p < .05$  was not obtained for each question as a result of Kruskal Wallis Test findings.

D) Spearman’s Correlation Coefficient Analysis Table 6 shows the change in Spearman’s correlation coefficient that demonstrate positive and negative effect resulting from each question asked to science teachers on nuclear energy and its technology based on gender, branch and total number of years in the occupation. Correlation coefficient being 1.00 shows a perfect correlation, -1.00 shows a negative correlation and 0.00 shows no correlation. In interpreting the correlation coefficient in terms of its magnitude, although intervals on which a complete agreement were non-existent, It should be noted that the following limits could be frequently used in interpreting the correlation: as absolute value, correlation coefficient being in the range of 0.70-1.00 can be defined as high, 0.69-0.30 as medium, and 0.29-0.00 can be defined as a low correlation (Buyukozturk 2008).

From the analysis of Table 6, it was observed that there was positive and significant relation between gender and questions in 6 questions on a medium level, positive and significant in 2 questions on a lower level, and no significant

**Table 6: Changes in Spearman's correlation coefficients according to branches Nonparametric Correlations**

Question		Gen- der	Bra- nch	Dur. in occu- pation
q1	Correlation Coefficient	.30**	-.35**	-.02
	Sig. (2-tailed)	.00	.00	.86
q2	Correlation Coefficient	.34**	-.31**	.02
	Sig. (2-tailed)	.00	.00	.84
q3	Correlation Coefficient	.36**	-.34**	-.02
	Sig. (2-tailed)	.00	.00	.85
q4	Correlation Coefficient	.29*	-.30**	.18
	Sig. (2-tailed)	.01	.00	.13
q5	Correlation Coefficient	.24*	-.13	.13
	Sig. (2-tailed)	.03	.25	.27
q6	Correlation Coefficient	.43**	-.20	.05
	Sig. (2-tailed)	.00	.09	.68
q7	Correlation Coefficient	.38**	-.30**	.03
	Sig. (2-tailed)	.00	.00	.74
q8	Correlation Coefficient	.40**	-.21	.09
	Sig. (2-tailed)	.00	.07	.45
q9	Correlation Coefficient	.23	-.30**	-.10
	Sig. (2-tailed)	.05	.00	.37
q10	Correlation Coefficient	-.00	.09	.22
	Sig. (2-tailed)	.94	.44	.06
q11	Correlation Coefficient	.13	-.26*	-.14
	Sig. (2-tailed)	.28	.02	.24
q12	Correlation Coefficient	.05	-.24*	-.14
	Sig. (2-tailed)	.66	.03	.21

\*Correlation is significant when on 0.05 level (2-tailed).

\*\*Correlation is significant when on 0.01 level (tailed).

level of relation in the remaining 4 questions. While there were positive opinions on nuclear energy and its technology in 6 questions expressing positive and significant relation on a medium level and positive and significant relation in 1 question on a lower levels, only 1 question had a negative reply on nuclear energy and its technology. Especially in attitude scores of teachers according to their gender, it is important to reveal a medium-level positive and significant relation in 6 questions (1, 2, 3, 6, 7, and 8) and a low-level positive and significant relation in two questions. This result showed that scores of female teachers tend to increase in the event that the scores of male teachers increase as well, and scores of female teachers tend to decrease in the event that the scores of male teachers also decrease. Of the replies teachers provided to questions on the basis of branches, it was observed that there was medium-level negative and significant relation in 6 questions, low-level negative and significant relation in 2

questions, and no level of significant relation in the remaining 4 questions. The fact that there was medium- and low-level negative and significant relation in 8 questions demonstrates that if an attitude score in one branch tends to increase, attitude score in other branches tend to decrease or an opposite situation exists. Moving from this fact, it can be noted that science teachers generally demonstrated and attitude with medium- and low-level negative and significant relation concerning nuclear energy and its technology on the basis of their branches. And on the basis of duration of science teachers in the occupation, it was established that any positive or negative significant level of relation was non-existent between their attitudes towards nuclear energy and its technology.

E) When asked about the sources of information science teachers have on nuclear energy and its technology during interviews, male science teachers noted television and newspapers first, then periodicals, and thirdly school courses and course books, female science teachers noted television and newspapers first, then school courses and course books, and thirdly periodicals. It may be said based on analysis results and the conducted interviews that the news in media influenced opinions of science teachers on the establishment of nuclear power plants and the use of nuclear energy in Turkey, and the variability between the attitudes of female and male teachers stemmed from the different order of source of information they had and also male teachers influenced from cognitive sources and female teachers were under the influence of affective sources. It was observed especially from the interviews carried out with female science teachers that epistemological beliefs were effective on such issues as nuclear energy and its use.

## DISCUSSION

Today, Turkey is among the biggest 18 economies in the world, yet it is the only country that does not have nuclear technology. Turkey is also the wealthiest country in terms of Thorium which is nuclear fuel that can be used in fourth generation nuclear power plants. Turkey is foreign-dependent in meeting its energy needs at a rate of 70%. It is quite important for a country to have domestic, sufficient, cheap, and uninterrupted energy in terms of guarantee its future.



Moving to nuclear energy by attaching minimum importance to environment and safety and using the technology in Turkey bears quite a significance. For this reason, Turkey needs to show interest in next generation nuclear technologies and generate major projects on the issue.

Increased consumption of energy due to fast growth of the world economy and rise in population, industrialization and urbanization cause greenhouse gas emissions to increase climate change. Therefore, relations of energy, environment, and climate necessitated the provision of energy efficiency, use of energy technologies, and transition to nuclear energy that pollutes the environment much less compared to fossil fuels. In order to commence a clean energy management, it is necessary to encourage to use such energy resources as hydraulic, wind, solar, geothermal, biomass, and nuclear energy and to decrease the use of fossil fuels so as not to cause global warming. In energy production, safety, sustainability, and renewability should be taken as the basic reference.

Results obtained from this study conducted in order to analyze nuclear energy and its technology efficiency and future can be summed up as below:

For the 21<sup>st</sup> century science teacher, energy is much more than obtaining and using it through a method of your choice. Nuclear energy and its technology that is sustainable, safe and have zero damage to environment, and that would not lead to issues in resource from the countries point of view as noted by science teachers should be moved on to in no time.

As a result of this study, it may be said that science teachers trust in nuclear energy and its technology and they have the opinion that the transition to this energy resource would be a gain for the country as their average total score of attitude towards the establishment of nuclear power plants and the use of nuclear energy in Turkey was  $X_{total}=35.93$ . These opinions of science teachers on nuclear energy and its technology are also supported by the relevant sources found in literature (US Environmental Protection Agency 1978; TAEK (Turkish Atomic Energy Authority) 2000; Atilgan 2004; Kulebi 2007; Kenar 2011).

General attitudes of the teachers participated in the study on nuclear energy and its tech-

nology demonstrated difference depending on gender and branch, however, a difference was not found in terms of occupation duration of working. Male teachers have positive viewpoints on the establishment of nuclear power plants in Turkey, effects of nuclear power plants on the environment, and energy policies in Turkey compared to female teachers. It is believed that this result can be handled from two different angles. First of these is that female teachers have more affective attitudes towards the environment compared to males, and as a result, it is believed that they may have developed negative attitudes towards the establishment of nuclear power plants and their effects on the environment. This finding demonstrates a parallelism with the findings of the study by Yalmanci and Gozum (2011) on the attitudes of male and female teacher candidates towards the environment.

Secondly, due to the fact that males show more interest in political sciences and politics, their political opinions on attitudes and views on nuclear power plants planned to be established in Turkey and the use of nuclear energy may have been influencing. However, as can be observed in average scores of female and male science teachers in replies to questions 10 and 12, it is quite meaningful that they exhibited a similar attitude in questions that read "I have concerns over worldwide nuclear armament" and "I believe the establishment of nuclear power plants in our country bears a political meaning".

In the replies to some questions, differences were observed between the degrees the teachers who participated in the study hold, that is, their branches and their attitudes towards nuclear energy and its technology. This is believed to stem from the courses that teachers enrolled during their bachelor degree education. Among the science teachers, teachers developing an ecocentric approach and viewpoint due to the fact that courses physics teachers took mostly included nuclear energy and its technology, chemistry teachers took nuclear energy and its formation, and biology teachers took natural sciences and environment-related caused different attitudes to be expressed on the basis of branches. This also supports the view suggested by Can (2004) that the infrastructure of knowledge an individual has bears significance in the decision-making process of that person.

This study demonstrated that, in addition to gender and branch, epistemological beliefs of female science teachers observed especially through inferences from interviews conducted with teachers also influence the attitudes of science teachers towards the establishment of nuclear power plants in Turkey and the use of nuclear energy. These attitudes of female teachers are also observed to be supported by numerous studies that investigate the effects of epistemological beliefs on attitudes (Aypay 2011; Chai et al. 2006; DeBacker and Crowson 2006; Kizilgunes et al. 2009; Sinatra and Kardash 2004).

When analyzed the change in Spearman's correlation coefficient showing the effect of each question on nuclear energy and its technology asked to science teachers on the total attitude scores of teachers, factor analysis results, and the Cronbach's Alpha reliability coefficient as 91%, the reliability of questions in the prepared attitude scale can be said that they were high, and that they measured the same attitude and performance exhibited as the target.

While most of the developed countries in the world meet their energy needs using nuclear power, the fact that we are still discussing nuclear energy and its technology results from a serious lack of knowledge. This is why, if it is possible in the opinions of science teachers to enlighten next generations on the issue by increasing the number of curricula on nuclear energy and its technology, positive gains can be obtained in terms of the future of countries.

In questions that read "I believe us having nuclear power taking into consideration the strategic significance of the geographical location of Turkey" and "I believe nuclear energy will be on the rise again and that nuclear energy has a future" that demonstrate a good correlation between the questions asked to science teachers and their gender, that science teachers exhibiting a similar stance is an issue worthy of attention. In addition to these opinions of science teachers, it may be noted that they believe possessing nuclear power would be a deterrent power factor in military terms due to the location of the country bearing in mind the strategic significance of the geographical location of Turkey. This is why science teachers may be said to be largely under the influence of patriotic feelings while shaping a decision on the establishment of nuclear power plants and the use of nuclear energy. However, that science teachers support

nuclear energy and its technology on one hand and exhibit a common attitude towards the damages nuclear energy could give to environment on the other hand also bear quite an importance.

People that gravitate towards mass communication media in order to obtain information and especially for recreational purposes expose themselves to an intensive manipulation. Researches show that mass communication media which has no alternatives most of the time makes its influence on people even more everyday thanks to the effect of education, culture, geography, economic condition, or other factors. From the analysis results and the conducted interviews, it may be suggested that the opinions of science teachers on the establishment of nuclear power plants in Turkey the use of nuclear energy are contributed by the news found in media, and that the attitude variability between female and male teachers stems from the fact that knowledge resources they have different ordering.

## CONCLUSION

According to science teachers, there is an absolute benefit in establishing nuclear energy and its technology with nuclear research centers and laboratories in the country in near future since teachers expressed their opinion that this would generate a maximum benefit in terms of the development of countries as nuclear energy and its technology has a very low margin of error and requires very less high performance in the field of industry.

However, teachers also highlighted the fact that, while moving on to nuclear energy and its technology, safety should be maintained at the maximum, its effects on environment and nature should be kept at the minimum and long-term environmental policies should be made. Environmental protection programs that have been prepared especially since 1960s and that include vast societies have revealed how issues that would arise if the nature is not preserved would pose a danger to all living creatures. In our country, this has recently found a place on the agenda. When analyzed the environmental issues, the solution seems to be possible by a friendly view to the environment and nature. This could only become a reality by providing a serious environmental education, not by exaggerated manipulation of printed and visual media. Environment and the education of environment

should start from the pre-school period and be provided in line with the principle of spiraling within the scope of entire issues on the subject. This way, individuals that develop positive attitude towards the environment can be introduced to society.

### RECOMMENDATIONS

Science teachers must be educated well on renewable energy resources and especially on nuclear energy and its technology, and they should raise awareness among the public on the issue as much as they can by addressing the public directly without causing any misunderstandings. To this end, courses that are included in the curriculum on nuclear energy and its technology should absolutely be given a place in primary education, secondary education, and bachelor degrees of the schools of education in line with the principle of spiraled in education and training. This study was conducted for science teachers and it should also be carried out on lower and upper levels of the society. Research that manifest the efficiency of transition to nuclear power and its technology in the long-run should absolutely be conducted as well.

### LIMITATIONS

1. The study is limited to data obtained during 6 hours of application every day totaling 60 hour by the author on 71 science teachers working at Kutahya Science High School and the entire Anatolian Teacher Training and Anatolian High Schools in 2010 summer term.
2. The study is limited to the permit of Governorship of Kutahya, Provincial Directorate for National Education.

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**APPENDIX**

**Study of scale expressing the opinions of science teachers (Physics-Chemistry-Biology) on nuclear energy and its technology**

<i>Questions</i>	<i>Items of the scale</i>	<i>Likert score</i>				
		5	4	3	2	1
<i>Opinions of Science Teachers on Nuclear Energy and its Technology</i>	1	I approve the establishment of nuclear power plants in our country.				
	2	I believe having nuclear energy and its technology would be beneficial for the development of our country.				
	3	I approve nuclear energy policies of Turkey.				
	4	I believe nuclear power plants may have harmful effects on the environment.				
	5	I believe I am equipped with sufficient information on nuclear energy.				
	6	I believe having nuclear power would be good considering the Strategic significance of the geographical location of Turkey.				
	7	Benefiting from nuclear energy in power generation is a good preference.				
	8	I believe nuclear energy will be on the rise again around the world and nuclear energy have a future.				
	9	I approve the establishment of Russian-design nuclear power plant in Turkey.				
	10	I have concerns over worldwide nuclear armament.				
	11	Nuclear energy should be deserted and different energy alternative should be sought.				
	12	I believe the establishment of a nuclear power plant in our country bears a political meaning.				