Valley International Journals
Open Access Journal
The International Journal of Social Sciences and Humanities Invention
Volume 2 issue 11 2015 page no.1669-1678 ISSN: 2349-2031
Available Online At: http://valleyinternational.net/index.php/our-jou/theijsshi

Pre-Service Teachers' Attitudes Towards Nuclear Energy And The Effect Of Fukushima Nuclear Disaster On Their Attitudes

Orhan Ercan[1], Evrim Ural[2], Ahmet Tekbıyık[3]
[1]Dr., Kahramanmaraş, Turkey
[2] Dr., Kahramanmaraş, Turkey
[3] Dr., Rize, Turkey

Abstract: ***This study aimed to investigate teacher candidates' attitudes towards nuclear energy and changes in their views about the construction of nuclear power plant after the Fukushima Nuclear Disaster. Working group of the study was composed of 484 teacher candidates attending the Faculties of Education of two Turkish State universities. Study findings present that 29% (N:129) of teacher candidates had positive views about the construction of nuclear power plants and Fukushima accident did not affect their views whatsoever. 47% (N:229) of teacher candidates did not wish nuclear power plants to be constructed and kept their views after the Fukushima incident whereas 23% (N = 113) of teacher candidates had positive opinions before the Fukushima incident but changed their views following the disaster. Findings show that approximately 50% of teacher candidates were against the construction of nuclear power plants and that 23% changed their views for the negative after the incident. Accordingly, the majority of teacher candidates was affected from the Fukushima incident and started to view the construction of nuclear power plants negatively. The study investigated teacher candidates' attitudes on nuclear energy as an alternative which is still a significant and current problem and their views after the recent Fukushima nuclear accident. It is necessary for teacher candidates to have sufficient information in order to develop opinions about any topic.***

I. INTRODUCTION

Today, "energy" concept plays a key role for the development of a modern society. In parallel to the rapid advances in technology, an energy policy must be figured out for sustaining technological developments and meeting the growing energy needs of society which has rising living standards. Fossil fuels lead to many problems. Among these problems, high carbon dioxide emission is very serious. Global warming which is a result of higher carbon dioxide emissions threatens a sustainable life in the world. For this reason, rapid de-carbonization of the world should be provided to stop global climate change [1]. Some proposals for the solution of the problem have been put forward. For example, Corner and Others (2011) state that the emissions of burning fossil fuels can be reduced by carbon capture and storage, but unfortunately resent carbon capture and storage technology has not been demonstrated meaningful results [2]. Another problem related to the fossil fuels is the limitation of these resources and many countries face with the threat of their increasingly high prices [3]. Due to the mentioned problems, countries search for alternative sources of energy. A sustainable energy policy should be reliable, clean and uninterrupted and also it is necessary to ensure the stability of prices. Due to environmental problems, it is desirable to have alternative sources with low carbon dioxide emissions. At this point, renewable energy sources and nuclear energy emerge as a solution. Renewable energy sources, despite their significant potential to meet the growing energy demand, they cannot completely meet energy need in the near future. Nuclear energy is an alternative energy source and produce electricity without greenhouse gases [3]. Nuclear energy provides energy facilities but at the same time brings the risks associated with radioactivity. Three Mile Island, Chernobyl and recently Fukushima Nuclear Power Plant accidents reveal these risks. Cicia and others (2012) mention that despite the problems and risk connected to the nuclear power generation, policy makers have been increasingly willing to use nuclear power [4]. Due to arrival of the serious level of climate change, "reluctant acceptance" concept has been used related to the views on nuclear energy [5].

When the social aspects related to nuclear energy considered, it is seen that generally individuals have negative views related to the subject. Individuals usually worry about the risks of nuclear energy will bring. But Yim and Vaganov (2003) think that people are poorly informed and negatively biased about this subject [6]. There are several variables that influence individuals' views on nuclear power usage. These variables can be listed as trust in regulators, governments, number of accidents and also personal characteristics. For example, De Groot, Steg and Poortinga (2013), search for the relationship between personal values and perceptions of risks, benefits and the acceptability of nuclear energy [7]. The results of the study display that people with altruistic and biospheric values think that nuclear energy has many risks and they are oppose to it, in contrast the people who believe that nuclear energy has beneficial consequences, they accept it. Individuals' information level related to a subject also affects their views about the subject. Sharma (2011), search for the effect of students' feelings and emotions in conjunction with their nuclear energy knowledge on their

DOI: 10.18535/ijsshi/v2i11.01

views and feelings about the use of nuclear energy [8]. The results display that following to the learning about nuclear energy, the non-science students are more accepting and open in respect of the use of nuclear energy than the science students. Having adequate information about the energy is very important to make right decisions. According to DeWaters and Powers (2011), well informed and energy literate people will make more thoughtful and responsible decisions and actions about the subject [9]. Individuals' environmental concern is also effective while shaping their opinions regarding nuclear energy. Bamberg (2003) states that the level of environmental concern has a strong influence on people's views and decisions related to environmental subjects like energy usage, recycling etc. [10]. Similarly, Corner and others (2011) express that generally people who worry about global climate change and positive environmentally attitudes have negative attitudes about nuclear power [2].

Nuclear power plant accident is one of the factors which deeply impress the views of the society related to nuclear energy. As a result of the great East Japan Earthquake, 19.0 moment magnitude from about 80 miles off the east coast [11], of March 2011, Fukushima Nuclear Power Plant accident happened. The accident caused a great discussion among Japanese people about the use of nuclear power [12]. The accident also created serious social unease in the surround region, because of the radioactive contamination and its' short and long term harmful influences on health [13]. Around 15000 tera becquerels of caesium-137 was released from the Fukushima reactor, that amount was 168.5 times that of the atomic bomb on Hiroshima [14]. Following to the accident, radio nuclides ranged over great distances rapidly and this displays the global impact of the accident [15]. After the accident, many countries began to reconsider their energy policies. The Fukushima Nuclear Accident make the global society worry about nuclear power plants and start to change their energy policies [11]. According to Prati and Zani (2012), nuclear accident can influence the public attitudes easily [16]. Their research results display that following to the Fukushima accident there is a significant increase in environmental beliefs and decrease positive attitudes towards nuclear energy. Similarly, Visschers and Siegrist (2013), and Neuman and Hopf (2013) display that the acceptance of nuclear power is become more negative after the accident [17,18]. Bhanthumnavin and Bhanthumnavin (2014) state that after the Fukushima nuclear accident, many countries become reluctant to use nuclear energy [3].

Just as in other developing countries, in Turkey, in parallel to the growing population and growing economy, demand for energy is increasing. Increasing energy demand prompts Turkey to search for constructing nuclear energy power plants [19]. In Turkey, 2 nuclear power plants (Mersin and Sinop) construction have been continued. In parallel to the construction of nuclear power plants, nuclear energy which is one of socio-scientific subjects has become the subject of debate in the community. According to the Kılınç, Boyes and Stanisstreet (2013), nuclear energy has a negative image [19]. They search for the views of students about nuclear energy. The results of the study display that even though half of the students believe that nuclear energy can supply sufficient energy, 75 % of the students think that nuclear power plants have negative effects on human and environment. Only few of the students think that nuclear energy can help to decrease greenhouse gases and stop global warming. Kenar (2013), search for the issue of nuclear power plants, use of nuclear energy and opinions of science teachers about the issue [20]. The results of the study display that in terms of gender, while male science teachers exhibit a positive attitude towards nuclear energy and technology; female science teachers have negative attitudes towards the issue. In terms of branches, science teachers generally demonstrate a positive stance on nuclear energy and its technology in general. According to Kenar (2013), individuals' knowledge level related to the subject is quite limited and generally they have prejudices about nuclear energy [20]. Chernobyl nuclear power plant accident occurred in 1986 caused people begin to thing negatively related to nuclear energy. In Turkey, where people have no experience in nuclear energy up to now, it is seen that people have negative views related to the subject. He, Mol, Zhang and Lu (2014) state that people in countries with a tradition of nuclear power plants are more trusted compared to people who live in countries without nuclear power production [5].

II. PURPOSE OF THE STUDY

This study aimed to investigate teacher candidates' attitudes towards nuclear energy and changes in their views about the construction of nuclear power plant after the Fukushima Nuclear Disaster.

III. RESEARCH MODEL

This study undertaken to identify the changes in teacher candidates' attitudes towards nuclear energy based on some variables is a descriptive filed study that utilizes survey model.

IV. SAMPLE

Working group of the study was composed of 592 teacher candidates attending the Faculties of Education of two Turkish State universities. 108 teacher candidates were excluded from the working group since they had missing data; therefore data obtained from 484 teachers were used in analysis. Table 1 presents data about the demographic characteristics of participating teacher candidates.

Table1. Demographic Characteristics of Teacher Candidates

	Characteristic	*N*	*%*
University	A	261	53,9
	B	223	46,1
Gender	Female	336	69,4
	Male	148	30,6
Year	1	137	28,3
	2	114	23,6
	3	135	27,9
	4	98	20,2
Parental Location of	Marmara	60	12,4

DOI: 10.18535/ijsshi/v2i11.01

Residence	Mediterranean	169	34,9
	Central Anatolia	43	8,9
	Black Sea	110	22,7
	Eastern Anatolia	45	9,3
	Southeastern Anatolia	57	11,8

While 54% (N = 261) of the participating teacher candidates attend a state university in the Black Sea region, 46% (N = 223) attend a state university in the Mediterranean region. 69% (N = 336) of the teacher candidates were females and 31% (N = 148) were males. 28% (N = 137) of the participants attended Year 1., 24% (N = 114) Year 2, 28% (N = 135) Year 3 and 20% (N = 98) attended Year 4. Parental location of residence showed that families of 12% (N = 60) of the participants lived in Marmara, 35% (N = 169) in Mediterranean, 9% (N = 43) in Central Anatolia, 23% (N = 110) Black Sea, 9% (N = 45) in Eastern Anatolia and 12% (N = 57) in Southeastern Anatolia regions.

V. DATA COLLECTION TOOLS

Data collection tool composed of two sections was used in the study to identify teacher candidates' attitudes towards nuclear energy and nuclear power plants. The first section was consisted of items related to demographic variables such as gender, age etc. In this section, there was also a question related to the effect of Fukushima Nuclear Accident on teacher candidates' views related to the construction of nuclear power plants. The question is given below:

"How does Fukushima nuclear power plant accident in Japan after the earthquake affect your views related to nuclear power plants planned to be established in our country?"

( ) My vision has not changed; I have already supported the establishment.

( ) My vision has not changed; I have never supported the establishment.

( ) My vision has changed; I don't want the establishment anymore.

( ) My vision has changed; now I want the establishment.

( ) This issue does not interest me.

The second part of the data collection tool was Nuclear Energy Attitude Scale. The Scale was developed by Özdemir and Çobanoğlu [21]. The scale is composed of 4 sub dimensions with a total of 20 Likert-type positive and negative statements that identify attitudes towards nuclear energy. Respectively, the scale dimensions are "construction of nuclear plants in Turkey (CNPT)", "environmental effects of nuclear plants (EENP)", "worldwide nuclear armament (WWNA)" and "energy policies of Turkey (EPT)". Items 8, 12, 13, 14, 15, 16, 19, 20 were grouped under CNPT; 1, 2, 3, 4, 7, 18 under EENP; 5, 6, 7 under WWNA and 9, 10, 11 under EPT sub dimensions. Cronbach alpha internal consistency coefficient of the original scale was found to be 0,88 and the internal consistency coefficient was calculated as 0,89 in the current study. Following rating were used in the positive statements "Completely disagree=1, disagree=2, unsure=3, agree=4 and completely agree=5" and negative statements were coded in reverse. "Interval range= (range)/ number of group" Formula was used to assess arithmetic means and score intervals were identified as 4/5 = 0,80. Table 2 presents the score intervals obtained in this manner.

Table 2. Score intervals for Likert type scale

Level	Score Interval
(5) Completely Agree	4,21-5,00
(4) Agree	3,41-4,20
(3) Unsure	2,61-3,40
(2) Disagree	1,81-2,60
(1) Completely Disagree	1,00-1,80

VI. FINDINGS

This study examined the changes in teacher candidates' views regarding nuclear power plants following the nuclear disaster in which substantial amounts of radioactive materials were released from the Fukushima nuclear power plant. Table 3 presents the findings.

Table 3. Views of Teacher Candidates on Fukushima Incident

Abbreviation	State	N	%
X_1	I wanted the construction of nuclear power plants before as well and Fukushima incident did not change my opinion.	142	29,3
X_2	I have never wanted the construction of power plants therefore the Fukushima incident did not change my opinion.	229	47,3
X_3	I used to support the idea but after Fukushima I do not want the construction of nuclear power plants.	113	23,3

Table 3 shows that teacher candidates' views are collected under three categories: teacher candidates who have supported the construction of nuclear power plants before and whose positive views were not affected by the Fukushima incident (X_1) (29%, N 129); teacher candidates who were against the construction of nuclear power plants before and whose negative views were not affected by the Fukushima incident (X_2) (47%, N = 229) and teacher candidates who had positive views regarding the construction of nuclear power plants before the Fukushima incident but whose views were changed for the negative (X_3) (23%, N = 113). According to the findings, the majority of teacher candidates were found to have been affected by the incident in Fukushima and have negative views regarding the construction of nuclear power plants.

Distribution of the changes in teacher candidates' views on nuclear power plants based on regions after the Fukushima

DOI: 10.18535/ijsshi/v2i11.01

incident was calculated in terms of percentages and frequencies and the findings are presented in Table 4.

Table 4 presents the findings that 27% of teacher candidates (N = 16) whose families reside in Marmara region have positive and 52% (N = 31) have negative views on nuclear power plants whereas 22% started to feel negative following the Fukushima incident. It can be claimed that teacher candidates excluding the ones whose families reside in Eastern Anatolia have negative views on nuclear power plants in general. 44% of teacher candidates whose families reside in Eastern Anatolia region have positive opinions on nuclear power plants which were not affected by the Fukushima incident. Similarly, teacher candidates whose families reside in Black Sea regions also have significantly positive views on nuclear power plants. It is observed that Fukushima incident had the most effect on the teacher candidates whose families are located in Southeastern Anatolia region. It can be claimed that compared to teacher candidates whose parents live in other regions, the views of teacher candidates whose parents live in Southeastern Anatolia region are changed following the Fukushima incident and they started to feel opposition towards the construction of nuclear power plants.

Examination of Table 4 in terms of total percentages shows that teacher candidates from the Mediterranean region have kept their positive outlooks to nuclear power plants before and after the Fukushima incident. It was also identified that teacher candidates who have negative views on nuclear power plants before and after the Fukushima incident have families residing in Mediterranean and Black Sea regions. It can be argued that teacher candidates whose families live in Mediterranean and Black Sea regions are highly affected from the incident in Fukushima.

Table 4. Distribution of Views on Fukushima Incident According to Regions

State		*Marmara*		*Mediterranean*		*Central Anatolia*		*Black Sea*		*Eastern Anatolia*		*Southeastern Anatolia*	
		N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
X_1	In-Group	16	26,7	46	27,2	12	27,9	36	32,7	20	44,4	12	21,1
	Total		3,3		9,5		2,5		7,4		4,1		2,5
X_2	In-Group	31	51,7	80	47,3	21	48,8	54	49,1	16	35,6	27	47,4
	Total		6,4		16,5		4,3		11,2		3,3		5,6
X_3	In-Group	13	21,7	43	25,4	10	23,3	20	18,2	9	20,0	18	31,6
	Total		2,7		8,9		2,1		4,1		1,9		3,7
GENERAL TOTAL		60	12,4	169	34,9	43	8,9	110	22,7	45	9,3	57	11,8

Findings regarding the arithmetic means of teacher candidate attitudes towards nuclear energy are presented in Table 5.

Table 5. Nuclear Energy Attitude Scores of Teacher Candidates

Abbreviation	*Factors*	$\bar{X}$	*SS*
CNPT	Construction of nuclear plants in Turkey	3,32	0,87
EENP	Environmental effects of nuclear plants	1,82	0,82
WWNA	Worldwide nuclear armament	2,34	0,91
EPT	Energy policies of Turkey	2,32	0,91
Total	Total nuclear energy attitude	2,57	0,65

Table 5 presents that teacher attitudes were mostly at the level of unsure ($\bar{X}$ = 3,32) for the first sub dimension of the nuclear energy attitude scale. It is observed that teacher candidates are undecided about the construction of nuclear power plants. Teacher candidates were found to have negative attitudes about the other sub dimensions and mostly present an attitude of disagreement. Accordingly, it can be claimed that teacher candidates have negative attitudes towards nuclear energy in terms of environmental effects of nuclear plants ($\bar{X}$ = 1,82), worldwide nuclear armament ($\bar{X}$ = 2,34), energy policies of Turkey ($\bar{X}$ = 2,32) sub dimensions and total nuclear energy attitudes ($\bar{X}$ = 2,57).

The study investigated the changes in teacher attitudes towards nuclear energy in terms of gender and the findings are presented in Table 6.

Table 6. Nuclear Energy Attitude Scores Based on Gender

Factor	*Gender*	*N*	$\bar{X}$	*SS*	*t*	*p*
CNPT	Female	336	3,21	0,79	-4,478	0,000
	Male	148	3,58	0,97		
EENP	Female	336	1,69	0,74	-5,685	0,000
	Male	148	2,13	0,9		
WWNA	Female	336	2,24	0,85	-3,375	0,001
	Male	148	2,54	1,00		
EPT	Female	336	2,20	0,82	-4,503	0,000
	Male	148	2,60	1,05		
Total	Female	336	2,45	0,58	-6,261	0,000
	Male	148	2,84	0,73		

Table 6 points to significant differences between teacher candidates' gender and sub dimensions of nuclear energy attitudes, total attitudes and information literacy. According to the findings, CNPT (t(482) = -4,478; p = 0,000 < 0,01), EENP (t(482) = -5,685; p = 0,000 < 0,01), WWNA (t(482) = -3,375; p = 0,01 < 0,005), EPT (t(482) = -4,503; p = 0,000 <

DOI: 10.18535/ijsshi/v2i11.01

0,001) sub dimensions and total nuclear energy scores were found to be in favor of males and this difference was statistically meaningful. The study examined the changes in nuclear energy attitude scores in relation with the teacher candidates' universities and the findings are presented in Table 7.

Table 7. Nuclear Energy Attitude Scores Based on University

Factor	*University*	*N*	$\bar{X}$	*SS*	*t*	*p*
CNPT	A	261	3,26	0,84	-1,598	0,111
	B	223	3,39	0,89		
EENP	A	261	1,78	0,73	-1,316	0,189
	B	223	1,88	0,92		
WWNA	A	261	2,33	0,82	-0,155	0,877
	B	223	2,34	1,00		
EPT	A	261	2,31	0,85	-0,324	0,746
	B	223	2,33	0,99		
Total	A	261	2,53	0,61	-1,443	0,150
	B	223	2,62	0,70		

Table 7 points that arithmetic means of nuclear energy attitude scores presented small changes in CNPT (t(482) = -1,598; p = 0,111 > 0,05), EENP (t(482) = -1,316; p = 0,189 > 0,05), WWNA (t(482) = -0,155; p = 0,877 > 0,05), EPT (t(482) = -0,324; p = 0,746 > 0,05), total score (t(482) = -1,443; p = 0,150 > 0,05) and the change was not statistically significant. The study also investigated whether there were significant relationships between teacher candidates' nuclear energy attitude scores and their class levels and findings are presented in Table 8.

Table 8 shows that attitudes related to EPT [F(3,480) = 1,980; p = 0,116 > 0,05] sub dimension did not change based on class level but CNPT [F(3,480) = 2,866; p = 0,036 < 0,05], EENP [F(3,480) = 3,842; p = 0,010 < 0,05], WWNA [F(3,480) = 4,064; p = 0,007 < 0,01], total nuclear energy attitude [F(3,480) = 5,276; p = 0,001 < 0,01] scores were affected from class level. Results of Bonferroni analysis undertaken to decide the origin of the difference presented that the difference was in favor of Year 4 between Year 1 and Year 4 and between Year 2 and Year 4 for CNPT sub dimension; the difference was in favor of Year 4 between Year 1 and Year 4, between Year 2 and Year 4, between Year 3 and Year 4 for EENP sub dimension; the difference was in favor of Year 3 between Year 1 and Year 3, in favor of Year 4 between Year 1 and Year 4 and in favor of Year 4 between Year 2 and Year 4 for WWNA sub dimension. Also, the difference was found to be in favor of year 4 between Year 1 and Year 4 in terms of total nuclear energy attitude scores.

Table 8. Nuclear Energy Attitude Scores Based on Year

Factor	*Year*	*N*	$\bar{X}$	*SS*	*Source of Variance*	*Sum of Squares*	*F*	*p*	*Difference*
CNPT	1	137	3,23	0,84	Between Groups	6,377	2,866	0,036	1-4 2-4
	2	114	3,20	0,77					
	3	135	3,38	0,85	In-Group	355,982			
	4	98	3,50	1,00					
EENP	1	137	1,71	0,83	Between Groups	7,604	3,842	0,010	1-4 2-4 3-4
	2	114	1,76	0,68					
	3	135	1,82	0,73	In-Group	316,685			
	4	98	2,06	1,01					
WWNA	1	137	2,17	0,87	Between Groups	9,839	4,064	0,007	1-3 1-4 2-4
	2	114	2,24	0,73					
	3	135	2,45	0,85	In-Group	387,381			
	4	98	2,52	1,15					
EPT	1	137	2,21	0,86	Between Groups	4,939	1,980	0,116	-
	2	114	2,27	0,79					
	3	135	2,35	0,90	In-Group	399,089			
	4	98	2,49	1,12					
Total	1	137	2,46	0,59	Between Groups	6,577	5,276	0,001	1-4
	2	114	2,49	0,55					
	3	135	2,62	0,63	In-Group	199,430			
	4	98	2,77	0,81					

DOI: 10.18535/ijsshi/v2i11.01

Table 9 presidents the change in teacher candidates' nuclear energy attitude scores based on the location of parental residence. Table 9 shows no significant differences between the region of parental residence and CNPT [F(5,478) = 0,682; p = 0,638 > 0,05], EENP [F(5,478) = 0,791; p = 0,557 > 0,05], WWNA [F(5,478) = 0,672; p = 0,645 > 0,05], EPT [F(5,478) = 1,011; p = 0,411 > 0,05], total nuclear energy attitude [F(5,478) = 0,862; p = 0,507 > 0,05] scores. It can be claimed that location of residence has no effect on nuclear energy attitudes.

Table 9. Nuclear Energy Attitude Scores Based on Location of Parental Residence

Factor	*View*	*N*	$\bar{X}$	*SS*	*Source of Variance*	*Sum of Squares*	*F*	*p*	*Difference*
CNPT	Marmara	60	3,24	0,87	Between Groups	2,565	0,682	0,638	-
	Mediterranean	169	3,34	0,89					
	Central Anatolia	43	3,37	0,79					
	Black Sea	110	3,26	0,82	In-Group	359,795			
	Eastern Anatolia	45	3,51	0,99					
	Southeastern Anatolia	57	3,29	0,85					
EENP	Marmara	60	1,76	0,69	Between Groups	2,661	0,791	0,557	-
	Mediterranean	169	1,77	0,83					
	Central Anatolia	43	1,85	0,79					
	Black Sea	110	1,81	0,79	In-Group	321,628			
	Eastern Anatolia	45	2,00	0,77					
	Southeastern Anatolia	57	1,91	1,02					
WWNA	Marmara	60	2,31	0,77	Between Groups	2,774	0,672	0,645	-
	Mediterranean	169	2,28	0,99					
	Central Anatolia	43	2,37	0,96					
	Black Sea	110	2,45	0,81	In-Group	394,446			
	Eastern Anatolia	45	2,41	0,98					
	Southeastern Anatolia	57	2,24	0,86					
EPT	Marmara	60	2,21	0,81	Between Groups	4,227	1,011	0,411	-
	Mediterranean	169	2,29	0,91					
	Central Anatolia	43	2,33	0,81					
	Black Sea	110	2,38	0,87	In-Group	399,802			
	Eastern Anatolia	45	2,56	1,10					
	Southeastern Anatolia	57	2,24	1,04					
Total	Marmara	60	2,50	0,60	Between Groups	1,840	0,862	0,507	-
	Mediterranean	169	2,55	0,65					
	Central Anatolia	43	2,61	0,65					
	Black Sea	110	2,57	0,61	In-Group	204,167			
	Eastern Anatolia	45	2,75	0,80					
	Southeastern Anatolia	57	2,56	0,68					

The study also investigated the influence of Fukushima incident on teacher candidates' nuclear energy attitude scores and Table 10 presents the findings.

DOI: 10.18535/ijsshi/v2i11.01

Table 10. Nuclear Energy Attitude Scores Based on Teacher Candidate Views on Fukushima Incident

Factor	*Durum*	*N*	$\bar{X}$	*SS*	*Source of Variance*	*Sum of Squares*	*F*	*p*	*Difference*
CNPT	A	142	4,02	0,78	Between groups	102,408	94,745	0,000	1-2 1-3 2-3
	B	229	2,95	0,74					
	C	113	3,20	0,67	In-Group	259,952			
	Total	484	3,32	0,87					
EENP	A	142	2,34	0,88	Between groups	53,238	47,237	0,000	1-2 1-3
	B	229	1,6	0,66					
	C	113	1,63	0,74	In-Group	271,051			
	Total	484	1,82	0,82					
WWNA	A	142	2,77	0,92	Between groups	37,690	25,212	0,000	1-2 1-3
	B	229	2,14	0,83					
	C	113	2,19	0,87	In-Group	359,530			
	Total	484	2,34	0,91					
EPT	A	142	3,03	0,89	Between groups	102,623	81,885	0,000	1-2 1-3
	NSİM	229	1,97	0,71					
	NSDV	113	2,13	0,82	In-Group	301,406			
	Total	484	2,32	0,91					
Total	A	142	3,18	0,55	Between groups	74,810	137,136	0,000	1-2 1-3
	B	229	2,28	0,52					
	C	113	2,42	0,49	In-Group	131,197			
	Total	484	2,57	0,65					

Table 10 presents significant differences in CNPT [F(2,481) = 94,745; p = 0,000 < 0,01], EENP [F(2,481) = 47,237; p = 0,000 < 0,01], WWNA [F(2,481) = 25,212; p = 0,000 < 0,01], EPT [F(2,481) = 81,885; p = 0,000 < 0,01], total nuclear energy attitude score [F(2,481) = 137,136; p = 0,000 < 0,01] based on Fukushima incident. For CNPT sub dimension this difference was found to be in favor of (A) between (A) and (B) [A: "teacher candidates who wanted the construction of nuclear power plants before the incident and who did not change their views based on Fukushima incident"; B:"teacher candidates who did not want the construction of nuclear power plants before the Fukushima incident"], in favor of (A) between (A) and (C) [A: "teacher candidates who wanted the construction of nuclear power plants before the incident and who did not change their views based on Fukushima incident"; C:"teacher candidates who supported the construction of nuclear power plants before the Fukushima incident, but changed their minds later"] and in favor of (C) between (B) and (C) [B:"teacher candidates who did not want the construction of nuclear power plants before the Fukushima incident", C:"teacher candidates who supported the construction of nuclear power plants before the Fukushima incident, but changed their minds later"]. For EENP, WWNA, EPT sub dimensions and total nuclear energy attitudes, the difference was found to be in favor of (A) between (A) and (B) [A: "teacher candidates who wanted the construction of nuclear power plants before the incident and who did not change their views based on Fukushima incident"; B:"teacher candidates who did not want the construction of nuclear power plants before the Fukushima incident"], in favor of (A) between (A) and (C) [: "teacher candidates who wanted the construction of nuclear power plants before the incident and who did not change their views based on Fukushima incident"; C:"teacher candidates who supported the construction of nuclear power plants before the Fukushima incident, but changed their minds later"]. Accordingly, it can be claimed that nuclear energy attitudes of teacher candidates who have not changed their views on the construction of nuclear power plants after the Fukushima incident can be said to be higher in EENP, WWNA, EPT sub dimensions and total nuclear energy attitudes. Findings in CNPT sub dimension that point to higher nuclear energy attitudes of teacher candidates who had positive views before the Fukushima incident but later changed their minds compared to teacher candidates who had always negative outlooks is a crucial finding in the study as well the significant difference between these two groups.

VII. RESULTS AND DISCUSSION

Study findings present that 29% (N:129) of teacher candidates had positive views about the construction of nuclear power plants and Fukushima accident did not affect their views whatsoever. 47% (N:229) of teacher candidates did not wish nuclear power plants to be constructed and kept their views after the Fukushima incident whereas 23% (N = 113) of teacher candidates had positive opinions before the Fukushima incident but changed their views following the disaster. Findings show that approximately 50% of teacher candidates were against the construction of nuclear power plants and that 23% changed their views for the negative after the incident. Accordingly, the majority of teacher candidates was affected from the Fukushima incident and started to view the construction of nuclear power plants negatively.

Following the Fukushima nuclear power plant accident, the radioactive release that was caused by the failure of the reactor resulted in reconsidering the issue of nuclear energy

DOI: 10.18535/ijsshi/v2i11.01

production. Similar studies undertaken after the accident presented results similar to the findings of the current study. For example, Arikawa, Cao and Matsumoto (2014) examined Japanese attitudes toward nuclear power and energy saving behavior after Fukushima accident [12]. The findings showed that energy consumption by Japanese people has decreased and the share of nuclear power in total electricity has decreased from 32 % to 2 % following the accident. Bhanthumnavin and Bhanthumnavin (2014) stated that the attitudes toward nuclear power plants seemed to be positive until the accident, but after the accident some negative attitudes increased [3]. Siegrist et. al. (2014) expressed that the nuclear accident in Fukushima has negatively influenced public acceptance of nuclear energy [22]. After the accident people noticed some of the risks related to the nuclear power generation. Kim, Kim and Kim (2013) also investigated the effects of Fukushima accident on public acceptance of nuclear energy in 42 countries [14]. The findings of the study revealed that opinions related to the nuclear power generation became negative after the accident. Findings of the current study and other studies in the literature point to the fact that individuals have started to view nuclear energy with a more negative perspective after the Fukushima nuclear accident. This accident brought the possible problems and risks in nuclear power plants to the agenda. Radioactive releases have a plethora of negative influences on living beings and these effects are not temporary and limited to the moment of accident but are long lasting. Individuals from all countries followed the news and unavoidably developed some negative attitudes since it was not possible to terminate the nuclear release after the incident and the topic was discussed in the media for days.

Investigation of the relationship between teacher candidates' nuclear energy attitude scores and their views following the Fukushima incident shows that in "construction of nuclear plants in Turkey (CNPT)" sub dimension, students who changed their views for the negative after the incident had more positive views compared to students who always had negative attitudes towards nuclear power plants. This finding also supports the view that experiences affect student attitudes. However, examination of the relationship between teacher candidates' nuclear energy attitude scores and their views on nuclear power plants following the Fukushima nuclear incident shows that teacher candidates who did not change their views after the accident had higher attitude scores.

Study findings present that teacher candidates whose parents reside in Eastern Anatolia and Black Sea regions have more positive opinions regarding the construction of nuclear energy plans with respective 44,4% and 32,7% ratios and it was observed that the ratio of teacher candidates with parental links to these regions who changed their views for the negative following the Fukushima nuclear incident was smaller compared to teacher candidates whose parents lived in other regions (Eastern Anatolia Region :20%; Black Sea Region: 18,2%). While the ratio of students who did not support the construction of nuclear power plants with families in the Eastern Anatolia region was 35,6%, this ratio was found to be approximately 50% in other regions. Examination of geographical locations and economic conditions of these regions sows that they are farther to economically developed regions and have undeveloped industries. The reason for positive views on nuclear power plants may be related to the belief that the plants will provide economic contributions to the region. While teacher candidates whose parents reside in Southeastern Anatolia changed their views for the negative following the Fukushima nuclear incident with a ratio of 31,6%, this ratio was found to be in 18,2%-25,4% interval for teacher candidates whose parents live in other regions. Findings show that Fukushima nuclear incident most negatively affected the teacher candidates whose parents reside in Southeastern Anatolia. Examination of the position of Southeastern Anatolia region shows that it has first-degree seismic zones although they are not as common as the western parts of Turkey. The fact that the accident was the result of an earthquake may have caused the teacher candidates from these regions to realize the risks of nuclear power plants in earthquake zones and negatively affected their attitudes. Similarly, Ertör-Akyazı et. al. (2012) investigated citizen preferences on nuclear and renewable energy sources and findings of the study displayed that most of the participants were opposed to the generation of nuclear power [23]. Teacher candidates' uncertainties may have been the result of several causes such as teacher candidates' prior information regarding nuclear energy and power plants and prior nuclear accidents (such as Chernobyl nuclear power plant accident). Prior accidents, negative effects of radioactive materials after such accidents and news in the media about these affect views negatively and foreign dependency in energy issues also affects individuals' decisions about these matters. It is believed that this dilemma has been effective in teacher candidates' uncertainties regarding the construction of power plants. Responses provided by the teacher candidates in "environmental effects of nuclear plants" sub dimension of the scale show that they believe nuclear wastes have no negative effect on environment. It is interesting that teacher candidates who are undecided about the construction of power plants believe nuclear wastes do not pollute the environment. Based on this finding, it is believed that teacher candidates have a lack of information about the conservation of nuclear wastes and their effects on the environment. Another reason behind the uncertainties about constructing nuclear power plants in Turkey may be related to the country's location on the earthquake zone. Teacher candidates' responses in the sub dimension "worldwide nuclear armament" show that they have perceived the difference between nuclear energy and nuclear weapons.

Study findings present a significant difference in the favor of male students between female and males in nuclear energy attitude scale sub dimensions and total attitude scores. Similarly, Honda, Wiwattanapantuwong and Abe (2014) investigated Japanese university students' attitudes about the Fukushima accident and the nuclear energy policies after the accident [24]. Their findings revealed that male students had more positive attitudes related to the nuclear energy compared to female students.

DOI: 10.18535/ijsshi/v2i11.01

Findings presented that observed changes in nuclear energy attitude scores were not significant based on the university teacher candidates attended or the location of parental residence. The study was conducted with students attending faculties of education. Lack of significant differences in attitude may have been the result of similarities in the student group.

Study findings show that attitudes towards energy policies in Turkey sub dimension did not change according to class level. However, while 1st and 2nd year students had more negative views regarding issues such as construction of nuclear power plants and environmental effects of nuclear wastes, 4th year students' attitudes are more positive. This difference may have been caused by teacher candidates' increased interest in contemporary issues and in news. Teacher candidates should have not only content information but also general knowledge. It is crucial for teachers who will raise the future generations to be educated as individuals who are informed about social events and who follow contemporary issues and technological advances. Current study investigated teacher candidates' attitudes on energy consumption and nuclear energy as an alternative which is still a significant and current problem and their views after the recent Fukushima nuclear accident. It is necessary for teacher candidates to have sufficient information in order to develop opinions about any topic. Therefore content of general information classes in teacher training programs should be updated and related classes should be revised with content that will develop awareness regarding social events and environments.

VIII. References

The heading of the References section must not be numbered. All reference items must be in 8 pt font. Please use Regular and Italic styles to distinguish different fields as shown in the References section. Number the reference items consecutively in square brackets (e.g. [1]).

[1] Pidgeon, N. and Demski, C. C. 2012. From nuclear to renewable: Energy system transformation and public attitudes. Bulletin of the Atomic Scientists, 68(4), 41–51.

[2] Corner, A., Venables, D., Spence, A., Poortinga, W., Demski, C., and Pidgeon, N. 2011. Nuclear power, climate change and energy security: Exploring British public attitudes. Energy Policy, 39, 4823–4833.

[3] Bhanthumnavin, D. and Bhanthumnavin, V. 2014. The empirical development of cognitive, affective, and behavioral tendency measures of attitudes toward nuclear power plants in Thai university students. Progress in Nuclear Energy, 73, 86-95.

[4] Cicia, C., Cembalo, L., Del Giudice, T., and Palladino, A. 2012. Fossil energy versus nuclear,wind,solar and agricultural biomass: Insights from an Italian national survey. Energy Policy, 42, 59–66.

[5] He, G., Mol, A. P. J., Zhang, L. & Lu, Y. 2014. Nuclear power in China after Fukushima: understanding public knowledge, attitudes, and trust. Journal of Risk Research, 17(4), 435-451.

[6] Yim, S. M. and Vaganov, P. A. 2003. Effects of Education on Nuclear Risk Perception and Attitude Theory. Progress in Nuclear Energy, 42(2), 221-235.

[7] De Groot, J. I. M., Steg, L., and Poortinga, W. 2013. Values, Perceived Risks and Benefits, and Acceptability of Nuclear Energy. Risk Analysis, 33(2), 307-317.

[8] Sharma, R. M. 2011. A comparative study of the impact of students' feelings regarding the use of nuclear energy. Science Education International , 22(1), 18-30.

[9] De Waters, J. E. and Powers, S. E. 2011. Energy literacy of secondary students in New York State (USA): A measure of knowledge, affect,and behavior. Energy Policy, 39, 1699–1710.

[10] Bamberg, S. 2003. How does environmental concern influence specific environmentally related behaviors? A new answer to an old question. Journal of Environmental Psychology, 23, 21–32.

[11] Park, E. Ohm, J. 2014. Factors influencing the public intention to use renewable energy technologies inSouth Korea: Effects of the Fukushima nuclear accident. Energy Policy, 65, 198–211.

[12] Arikawa, H., Cao, Y., and Matsumoto, S. 2014. Attitudes toward nuclear power and energy-saving behavior among Japanese households. Energy Research & Social Science, 2, 12–20.

[13] Yamane, F., Ohgaki, H., and Asano, K. 2013. The Immediate Impact of the Fukushima Daiichi Accident on Local Property Values. Risk Analysis, 33(11), 2023-2040.

[14] Kim, Y., Kim, M., and Kim, W. 2013. Effect of the Fukushima nuclear disaster on global public acceptance of nuclear energy. Energy Policy, 61, 822–828.

[15] Ioannidou, A., Manolopoulou, E. M., Stoulos, S., Vagena, E., Papastefanou, C., Bonardi, M. L., Gini, L., Manenti, S., and Groppi, F. (2014). Radionuclides from Fukushima accident in Thessaloniki, Greece (40_N) and Milano, Italy (45_) Journal of Radioanal Nuclear Chemistry, 299, 855–860.

[16] Prati, G. and Zani, B. 2012. The Effect of the Fukushima Nuclear Accident on Risk Perception, Antinuclear Behavioral Intentions, Attitude, Trust, Environmental Beliefs, and Values. Environment and Behavior, 45(6), 782–798.

[17] Visschers, V. H. M. and Siegrist, M. 2013. How a Nuclear Power Plant Accident Influences Acceptance of Nuclear Power: Results of a Longitudinal Study Before and After the Fukushima Disaster. Risk Analysis, 33(2), 333-347.

[18] Neumann, S.& Hopf, M. 2013. Students' Ideas About Nuclear Radiation – Before and After Fukushima. Eurasia Journal of Mathematics, Science & Technology Education, 9(4),393-404.

DOI: 10.18535/ijsshi/v2i11.01

[19] Kılınç, A., Boyes, E. and Stanisstreet, M. 2013. Exploring Students' Ideas About Risks and Benefits of Nuclear Power Using Risk Perception theories. Journal of Science and Educational Technology, 22, 252–266.

[20] Kenar, İ. 2013. Nuclear Energy Reality in Turkey and the Attitude of the Science Teachers towards the Issue. Anthropologist, 16(1-2), 153-165.

[21] Özdemir, N. and Çobanoğlu, E. O. 2008. Türkiye'de Nükleer Santrallerin Korunması ve Nükleer Enerji Kullanımı Konusundaki Öğretmen Adayların Tutumları. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (H.U. Journal of Education), 34, 218-232.

[22] Siegrist, M., Sütterlin, B., Keller, C. 2014. Why have some people changed their attitudes toward nuclear power after the accident in Fukushima? Energy Policy, 69, 356–363.

[23] Ertör-Akyazı, P., Adaman, F., Özkaynak, B., and Zenginobuz, Ü. 2012. Citizens' preferences on nuclear and renewable energy sources: Evidence from Turkey. Energy Policy, 47, 309–320.

[24] Honda, A., Wiwattanapantuwong, J., and Abe, T. 2014. Japanese university students' attitudes toward the Fukushima nuclear disaster. Journal of Environmental Psychology, 40, 147-156.

DOI: 10.18535/ijsshi/v2i11.01