JOURNAL OF BALTIC SCIENCE EDUCATION
ISSN 1648-3898

PRE-SERVICE TEACHERS' ATTITUDES TOWARD SOCIO-SCIENTIFIC ISSUES AND THEIR VIEWS ABOUT NUCLEAR POWER PLANTS

Hasan Ozgur Kapici,
Genc Osman Ilhan

Abstract. *There is not a common attitude in a society for socio-scientific issues (SSI) such as whether to use nuclear power plants for energy production. Within this respect, the aim of the research is to examine pre-service science teachers' and pre-service social studies teachers' attitudes toward SSI and to reveal their views about setting up nuclear power plants in their country. The participant of research is 120 pre-service teachers. Firstly, Attitudes toward Socio-scientific Issues Scale (ATSIS) was implemented and then, focus group discussions were done with five students from each department separately so as to understand their views about nuclear power plants. Findings revealed that whereas pre-service teachers are eager to learn more about SSI, they have anxiety about it due to religion, moral and ethical perspectives. In addition, whereas both groups of pre-service teachers have some common views about nuclear power plants, pre-service science teachers do not have more positive views about having nuclear power plants in their country.*

Key words: *attitude towards socio-scientific issues, focus group discussion, pre-service teachers, nuclear energy.*

Hasan Ozgur Kapici, Genc Osman Ilhan
Yildiz Technical University, Turkey

Introduction

Developments in science and technology have substantial impacts on society. For example, developments in fields like health, nutrition, harboring and security generally accepted by society but sometimes such kind of developments may cause polarizations in a society. In such situations, it is expected that individuals in a society may be able to make their own decisions based on scientifically valid knowledge. Indeed, this is a property of a scientifically literate person. Making decisions about socio-scientific issues based on scientifically valid knowledge is a vital part of scientific literacy, which is one of the crucial goals of science education (Topçu, Muğaloğlu & Güven, 2014). Scientifically literate individual is not learner only for during school term but also s/he is a life-long learner. NRC (1996) defines science literacy as understanding concepts, making decisions individually, acquisition of citizen consciousness, attending social and cultural activities in a society and being productive economically. In other words, scientifically literate person is able to make his/her own decision, is able to reach reliable sources (articles, books, etc.) about (socio-scientific) issues or at least, s/he is aware about how to reach such sources, is able to share his/her own idea in a society and is a economically productive. These traits emphasize that students should be taught not only scientific knowledge at schools but also they should be educated about how to develop their own ideas and thinking skills because there are topics related about society which are open-ended, contradictive and with not certain answers. This type of topics is called as socio-scientific issues (SSI) (Sadler, 2004; Topçu, 2010). A topic should be related with science contents and should have sense and importance about society so as to be called as SSI (Eastwood, Sadler, Zeidler, Lewis, Amiri & Applebaum, 2012; Topçu et al., 2014). Global warming, human cloning, stem cells, genetically modified organisms, and nuclear power plants are some examples for SSI.

Attitude towards an object is another indicator to understand what s/he thinks about it. Asking someone's attitude towards an object means that to ask how s/he judges the object (Kind, Jones & Barmby, 2007, p. 873). Although attitude is not much open to change and develop (Reid, 2006), it is an attractive topic for researchers since it is long-lived, related to behavior and is learned and be taught (Young, 1998, p.97). Reid (2006) advocates that attitude involves three main components which are cognitive, affective and behavioral. They are related to each other. Cognitive component is introduced as knowledge about an event, object or process. Affective component is defined as feeling or emotion about the object (e.g like or dislike) and lastly, behavioral component is identified as a tendency towards action for the object.

In related literature, although there are many studies (Bilen & Özel, 2012; Lewis & Leach, 2006; Ratcliffe, 1997; Sadler, 2009; Sönmez & Kılınç, 2012) done about SSI, studies about students' attitudes toward SSI are rare. The results of such studies show that students' achievements increases (Şahin & Hacıoğlu, 2010; Kırbağ Zengin, Keçeci & Kırılmazkaya, 2012), thinking and reasoning skills, inquiry and argumentation skills develops with SSI based curriculum (Demircioğlu & Uçar, 2014; Sadler & Zeidler, 2004; Zohar & Nemet, 2002). Students with these high level abilities will be able to solve problems that they face and will be able to make decisions based on scientifically appropriate knowledge, which are properties of scientifically literate person (Topçu et al., 2014).

In national perspective, one of the popular SSI is nuclear power plants, especially in Turkey since it is the first time that they are planning to be established. Recently, there are a lot of studies done about nuclear power plants in Turkey so as to investigate students and pre-service teachers' attitudes or knowledge about nuclear energy and nuclear power plants (Ateş & Saraçoğlu, 2013; Kırbağ Zengin et al., 2012; Özdemir, 2014). These studies conclude that most of students and pre-service teachers have bias about nuclear power plants and they believe that nuclear power plants have a lot of advantages although it involves many possible dangers (Ateş & Saraçoğlu, 2013). On the other hand, in terms of international perspective, after the Fukushima Daiichi nuclear disaster, nuclear power plants have started to occupy the agenda of societies. For example, opponents of nuclear power plants organized demonstrations against nuclear energy in France, where energy mainly produced by nuclear power plants (Petit, 2013).

Research Focus

Because of the fact that pre-service teachers are going to teach SSI in their future career at schools, they should be familiar with such SSI contexts. In addition, it is indispensible fact that SSI consists of social and scientific parts. For this reason, the participant pre-service teachers' branches were determined as social and science. In related literature, although it is possible to find studies which investigate pre-service science teachers' views about SSI, there has been no research which examines pre-service social studies teachers' attitudes toward SSI.

In other respect, SSI does not only involve international problems but also includes local subjects since each country (or community) has its own socio-cultural structure, moral values and beliefs (Topçu et al., 2014). Because of the fact that these values are usually different for each community, societies' perspectives may be different for the same SSI. Hence, local studies about SSI are important to reflect that community's views.

Moreover SSI is an important context to educate individuals as scientifically literate people because it requires an individual to reach reliable data sources and supporting his/her views with scientifically valid evidences. For this reason, it can be said that educating students as scientifically literate individuals is also depend on pre-service teachers' attitudes toward SSI, who will teach in their future career. Therefore, pre-service teachers' attitudes toward SSI and their views about nuclear power plant, which is an example for SSI, was examined in the current study.

This research was done to contribute related literature in order to address these deficiencies. The purpose of this research is to reveal pre-service science and pre-service social studies teachers' attitudes toward SSI and to examine their views about setting up nuclear power plants in Turkey. In addition, pre-service teachers' views about nuclear power plants were examined and compared with each other.

The main question is what pre-service teachers' attitudes toward SSI (positive or negative) and whether pre-service science teachers and pre-service social studies teachers have different views about setting up nuclear power plants in Turkey.

Methodology of Research

General Background of Research

Current research is based on mixed methodology. First of all, questionnaire was applied for both pre-service science teachers and pre-service social studies teachers as a quantitative part of research. Then focus group discussions, which are a kind of qualitative data collection method, were done with five pre-service science teachers and five pre-service social studies teachers, separately. Focus group discussions are done based on predetermined framework with respect to participants' specifications (Çokluk, Yılmaz & Oğuz, 2011). The study was done in the spring term of 2015-2016 academic year.

Sample of Research

The research was done with 60 pre-service science teachers and 60 pre-service social studies teachers. The descriptive details of participants were given on Table 1. There is no compulsory course about SSI in the two programs' curriculums but there is one course as an elective course related with SSI for each department. For example, in the spring term of second grade, pre-service social studies teachers may choose the elective course entitled as "Science, Technology and Change in Society". In other respect, pre-service science teacher may attend the elective course entitled as "Science, Technology and Society" in the spring term of second grade. The research was done at the end of the spring term in 2016. For this reason, the participants –except first grade pre-service teachers- were chosen among students who attended these elective courses. All participants filled out the questionnaire and attended focus group discussions as volunteer.

Table 1. Descriptive information about participants.

	Grade Level				Gender		Total
	First Grade	Second Grade	Third Grade	Fourth Grade	Male	Female	
Pre-service Science Teachers	10	10	20	20	8	52	60
Pre-service Social Studies Teachers	10	10	20	20	25	35	60

Instruments and Procedure

Firstly, in order to reveal pre-service science teachers and pre-service social studies teachers' attitudes about SSI, the questionnaire, which was developed by Topçu (2010), was used. It involves 30 items and has three subdimensions, which are interest and usefulness of SSI (17 items), liking of SSI (7 items) and anxiety towards SSI (6 items). It is a kind of 5-point Likert scale, from strongly disagree to strongly agree. Turkish form of the questionnaire was used in the research. The original questionnaire was developed with pre-service science teachers, pre-service elementary teachers and students from the department of psychology. All reliability and validity scores were provided by Topcu (2010). Because of the fact that totally the same questionnaire was used in current research, any new internal consistency reliability or any validity scores were not calculated. The Cronbach alpha coefficients of .90 were found for the interest and usefulness of SSI, .81 for the liking of SSI and .70 for the anxiety towards SSI in the original scale.

Secondly, two focus group discussions were done with pre-service teachers. The first one was done with five pre-service social studies teacher. The other one was done with five pre-service science teachers. Students in the focus groups were determined based on their scores gathered from the questionnaire. Two students from fourth grade, two students from third grade and one student from second grade were chosen for each focus group discussion. The students, who have the highest and the least positive attitudes scores, were chosen from third and fourth grades. For the second grade, the student, who has the average score from the questionnaire, was called for the group discussions. In order to understand two different groups' (pre-service science teachers and pre-service social studies teachers) views about setting up nuclear power plant in Turkey exactly, the pre-service teachers

were divided into two groups with respect to their branches. It was aimed through focus group discussions to understand what pre-service science teachers and pre-service social studies teachers think about nuclear power plants, how they support their views, whether they are affected from each other's view easily and what their decisions are about establishing nuclear power plants in Turkey.

Data Analysis

Relative frequency and percentage distribution techniques were used as descriptive analysis in order to analyze the data gathered from the questionnaire. Pre-service science teachers and pre-service social studies teachers' responses analyzed together in order to see general attitudes of pre-service teachers toward SSI.

On the other side, focus group discussions were transcribed and then analyzed. Each group's responses was evaluated and then compared with each other. Focus group discussion took about 40 minutes for each group. What nuclear energy is, how it works, the impacts of them on livings and environment, similarities and differences between nuclear power plants and other energy sources, importance of it for Turkey, whether they support the view to have nuclear power plant in Turkey (and why) were basis of the questions discussed in the focus group discussions. The questions were asked by one of the researchers and then each participant in the group explained his/her thoughts one by one. All discussions were recorded. Students' views were categorized into two sub-titles, one of which is positive views/true knowledge as coded 1 and the other one is negative view/wrong knowledge as coded 2.

Results of Research

Pre-service science teachers and pre-service social studies teachers' attitudes toward SSI and their thoughts about setting up nuclear power plants in Turkey were examined in the research. In the first part of the results section, the findings about attitude towards SSI, which were reached from the questionnaire, were presented. In the second parts, the data, which is pre-service teachers' views about setting up nuclear power plants, gathered from focus group discussions were given.

Results Received Based on the Questionnaire

The questionnaire has three sub-dimensions, which are interest and usefulness of SSI, liking of SSI and anxiety towards SSI. The findings based on the first sub-dimension of the scale, which is interest and usefulness of SSI, reveal that most of the pre-service teachers are eager to learn new developments about SSI. Table 2 shows the most chosen items by pre-service teachers.

Table 2. Findings related with interest and usefulness of SSI.

Item No	Item	Number of Participants	Percentage (%)
15	Since SSI is related to daily life, I would like to learn more details about SSI.	108	90.7
25	Debating on SSI promotes my thinking ability.	110	92.5
2	SSI provides me with an opportunity to understand science well.	112	94.2
30	I' am interested in the effects of SSI on society.	96	81.4
18	In media, the more emphasis should be given to SSI.	102	85.8

The results on Table 1 indicate that many pre-service teachers have positive attitudes toward interest and usefulness of SSI. Pre-service teachers believe that discussing about SSI helps them to develop their thinking skills. It is indispensible fact that daily events attract students' attention much more. It is also valid for this situation. Much more of participants advocate that SSI is related with daily life. Because of this, I prefer to learn more about it and it helps me to understand better. They want to learn more knowledge about the effects of SSI on society and they wish to see that more emphasis should be given to SSI in media.

The findings depend on another sub-dimension of the scale, which is liking of SSI, show that participants' interest about SSI is over the average level. Table 3 shows the most preferred items about liking SSI.

Table 3. Findings related with liking of SSI.

Item No	Item	Number of Participants	Percentage (%)
13	I like conducting research on SSI.	87	83.1
6	I like SSI much better than scientific issues.	65	54.6
21	I like trying to understand the actions around my environment with SSI knowledge.	78	66.1

The results on Table 3 show that over the half of pre-service teachers like SSI more than other scientific issues. They try to associate the events around him/her with SSI and eager to design research based on SSI.

The results based on the last sub-dimension of the scale, which is anxiety towards SSI, were given on Table 4. The findings reveal that some participants have several anxieties about SSI.

Table 4. Findings related with anxiety towards SSI.

Item No	Item	Number of Participants	Percentage (%)
12	I' am not approving implementations of SSI in terms of religion.	41	34.4
5	I' am worry about socio-scientific developments in terms of moral and ethical perspectives.	32	27.1
16	I think implementations of SSI are abused by the people having harmful targets.	68	56.7
19	Socio-scientific developments are harmful to society rather than its benefits.	12	10.1

The results show that 12 pre-service teachers have serious anxiety towards SSI and they believe that it involves much more dangerous outcomes for society than beneficial impacts. More than half of participants are worried since they think that SSI is open to be abused by the malevolent people. Also some pre-service teachers have anxiety towards SSI due to their religious or moral values or ethical issues. These results might show us how science and technology has strong effect on society.

Results Based on the Focus Group Discussions

After implementing the scale, the researchers choose 10 pre-service teachers (five of them are from the department of science education and the other five of them are from the department of social studies education) for focus group discussions. The participants were determined with respect to their questionnaire results. Two pre-service teachers from fourth grade in the department of science education (one of them has the highest score for attitudes toward SSI and the other one of them has the lowest score for the attitudes toward SSI) and two teachers from third grade in the department of science education (one of them has the highest score for attitudes toward SSI and the other one of them has the lowest score for the attitudes toward SSI) were chosen. One student from second grade in the department of science education, who has the most average score for attitudes towards SSI, was chosen. These five pre-service teachers in the department of science education were invited for the focus group discussion. Same process was followed for the pre-service social studies teachers. It was aimed in the focus group discussions so as to reveal pre-service teachers' views about an SSI example, which is nuclear power plant. In Turkey, there is a hot debate about establishing nuclear power plants, recently. The problems in the focus group discussions were generally about what nuclear power plant is, how it works, advantages/drawbacks of it and what you think about it. Discussions were organized for pre-service science teachers and pre-service social studies teachers separately. Two-point scale was used to evaluate the groups' views. One point represents false or negative views and two points represent true or positive views.

Table 5 shows the views of both groups of pre-service teachers' views about what nuclear energy is and how it works.

Table 5. Pre-service teachers' views about nuclear energy and its working principle.

Q1: What is nuclear energy and how does it work?	1	2
Pre-service Science Teachers' Views	*"Uranium and potassium combination take place at nuclear power plants to produce energy."* *"I can't explain how but excessive amount of energy is produced by very tiny parts of atoms"*	
Pre-service Social Studies Teachers' Views	*"Uranium and thorium transform into other energy forms such as electricity in nuclear power plants."* *"I do not know exactly how it works but as I know a lot of engineers, technicians and workers are needed."*	

At the beginning of focus group discussions, what nuclear energy is and how it works were discussed. Findings based on the interviews show that both groups of pre-service teachers do not have exact knowledge about nuclear power plants but pre-service social studies teachers have more real-like thoughts. Similarly, both groups of pre-service teachers do not have exact scientific knowledge about how nuclear power plants work.

In the next question, it was discussed that whether nuclear power plant is a kind of clean energy or not. Table 6 shows the thoughts of pre-service science teachers and pre-service social studies teachers. Whereas pre-service social studies teachers claim that nuclear power plants are cleaner than other energy sources such as hydroelectric power plants or wind energy facility, pre-service science teachers advocate that nuclear power plants are not a type of clean energy since they emit radiation.

Table 6. Pre-service teachers' views about nuclear energy

Q2: Is nuclear energy a kind of clean energy?	1	2
Pre-service Science Teachers' Views	*"Although a wind energy facility produces less energy than a nuclear power plant, former one is cleaner and I support the idea that much more wind energy facility should be launched."*	
Pre-service Social Studies Teachers' Views		*"I think that nuclear power plants are cleaner than other energy sources. For instance, hydroelectric power plants damage fish ecosystems in rivers in which they set up".*

After then it was asked that what they think about having nuclear power plants is one of the indicators to be assumed as developed country. The answers of both groups of pre-service teachers were given on Table 7.

Table 7. Pre-service teachers' views about the relation between having nuclear power plants and being a developed country

Q3: Do you think that having nuclear power plants is an indicator to be assumed as developed country?	1	2
Pre-service Science Teachers' Views		*"We can say that having a nuclear power plant can be considered as indicator to be assumed as a developed country since USA has many nuclear power plants and it is one of the developed countries."*
Pre-service Social Studies Teachers' Views		*"As I know, nuclear power plants are common in France and USA. These are two of developed countries. If we have nuclear power plants in our country, it seems to me that we will approach more to the developed countries."*

Pre-service teachers emphasized that having nuclear power plants may be considered for being assumed as a developed country. After their explanations, researcher asked that "*there are nuclear power plants in countries like Armenia or Ukraine* (these two countries were given as examples because they are neighbor of Turkey). *Are they developed countries?*" Students from social studies education stated that number of nuclear power plants in these countries should be taken into consideration. In other words, if a country has a lot of nuclear power plants, then this country can be categorized into developed countries. On the other side, pre-service science teachers could not give any detailed explanation for this question.

The following question was about where the nuclear power plants are planning to set up in Turkey. Table 8 shows pre-service teachers' responses for this question. Pre-service social studies teachers have more knowledge about the locations for nuclear power plants in Turkey. They know the cities. Nonetheless pre-service science teachers do not have more knowledge about places. However both groups of pre-service teachers do not have much more information about why these cities were chosen. In other words, they could not explain exactly why nuclear power plants should be close to sea.

Table 8. Pre-service teachers' answers for the question about locations of nuclear power plants in Turkey

Q4: In which cities, do the nuclear power plants are planning to set up?	1	2
Pre-service Science Teachers' Views	*"Rural areas like east region of Turkey"* *"…I would say that sea can absorb the dangerous gases released by nuclear power plants and decrease its negative impacts on environment. That's why, these cities were preferable."*	
Pre-service Social Studies Teachers' Views	*"Turkey is an earthquake-prone country and these two cities are safer places than most of other parts of Turkey. That's why, these cities were determined."*	*"Sinop and Akkuyu are two cities. Due to these cities are close to the ports, these cities were determined."*

Then, it was discussed that whether they know any nuclear accidents and what kind of effects can be seen on the environment after nuclear accidents. As can be seen from Table 9, Chernobyl and Fukushima nuclear accidents are two major examples given by both groups of pre-service teachers. The reasons of this finding could be Chernobyl was too close to Turkey and its effects still can be observed in north parts of Turkey and Fukushima nuclear accident was a case of recent vintage. Similarly both groups of pre-service teachers have common views about the results of nuclear power plants accidents.

Table 9. Pre-service teachers' views about effects of nuclear accidents

Q5: What are the effects of nuclear accidents on environment?	1	2
Pre-service Science Teachers' Views	*"I think that nuclear power plants accidents are one of the major sources for global warming and glacier melting."*	*"Ultraviolet lights released from nuclear power plants damage the atmosphere and people expose to hazardous lights much more."*
Pre-service Social Studies Teachers' Views		*"Nuclear power plant accidents gave rise to die thousands of people, animal and plants. For example, cancer became widespread in north side of Turkey. The worst result is that its effects can last for centuries."*

After that it was asked what kind of precautions can be taken in order to decrease nuclear power plants' drawbacks. Table 10 shows pre-service teachers' ideas about preventive precautions.

Table 10. Pre-service teachers' views about precautions against nuclear accidents

Q6: What kind of precautions can be taken in order to decrease nuclear power plants' drawbacks?	1	2
Pre-service Science Teachers' Views		*"We should invite experts from developed countries and should discuss with them about how we can set up nuclear power plants and how we can protect our citizens and environment."*
Pre-service Social Studies Teachers' Views		*"We should examine how developed countries established the nuclear power plants in their countries and how they protect their citizens. Then we should adapt them with respect to our country's situation."*

General view about taking measurements against nuclear power plants is that doing it as developed countries. Their system should be examined and be adapted for nuclear power plants in Turkey. On the other hand, although similar offers were done by pre-service science teachers, their main offer was using alternative energy sources firstly, if their products still do not satisfy the need, then we should start to think about how to set up nuclear power plants as the ones in developed countries.

Finally, their ultimate thoughts about establishing nuclear power plant in Turkey were asked. According to the findings, all pre-service social studies teachers supported the idea that nuclear power plants should be set up. They all said that although nuclear power plants have adverse impacts on environment even on people, if we have sufficient precautions, they should be set up since they are much more efficient than other energy sources which also have negative impacts on environment. On the other hand, a large part of pre-service science teachers claimed that alternative energy sources, which have less or no dangerous impacts on environment, should be given primacy. When all the other ways fail, after then nuclear power plants should be considered.

General result derived from the focus group discussions as following. Pre-service science teachers and pre-service social studies teachers could not explain how nuclear power plants work but both of the groups have similar views about its adverse impacts on environment and offered similar precautions to reduce its negative outcomes. They both think that having nuclear power plants can be assumed as an indicator for being developed country. They also gave similar examples as nuclear power plant accidents. On the other hand, while pre-service social studies teacher think that nuclear power plants are a kind of clean energy, pre-service science teachers do not agree with the opinion. At the end, while pre-service social studies teachers supported the idea which is to have nuclear power plants in Turkey, a large part of pre-service science teachers offered to give primacy for alternative energy sources.

Discussion

Pre-service teachers' attitudes toward SSI were examined in the study. Furthermore focus group discussions were done with pre-service science teachers and pre-service social studies teachers in order to reveal their views about setting up nuclear power plants in Turkey.

Pre-service teachers are eager to learn new developments about SSI because of the fact that they find SSI is related with daily life issues. They also want to learn more about the effects of SSI on society and want to see more emphasis on media about it. SSI can be attractive for pre-service science and pre-service social studies teachers owing to the fact that it represents both scientific and social problems (Sadler & Zeidler, 2005) which are also related with those pre-service teachers' teaching area. In addition, connecting the process, concept or problem with daily life also attractive for students and may give rise to deeper and meaningful learning. In current research, pre-service teachers claimed that they learn well by discussing SSI, which may be as a result of this fact. On the other hand, they have anxiety about SSI implementations due to religion, moral and ethical perspectives and have suspects since they think that SSI implementations are open to be abused by hazardous people. Indeed, this result can be expected for socially relevant scientific issues because society involves many types of people who are dangerous for others or people who have strong religious beliefs and who care more about moral values rather than scientific issues.

As a next step, focus group discussions were done with pre-service science teachers and pre-service social studies teachers in order to reveal their views about setting up nuclear power plants in Turkey and to see how they support their views. It was found that pre-service teachers from two branches have not much knowledge about how nuclear power plants work. Although they do not know how it works, they are aware of its effects on environments and have ideas about precautions. It is fact that SSI like nuclear energy or others are not much common topic in formal education to teach or discuss (Kılınç, Boyes & Stanistreet, 2013), so students generally learn about these through media or other informal sources such as family or friends (cf. Kılınç et al., 2013; Boyes & Stanistreet, 1994). That's why, SSI should be discussed at formal education centers rather than popular media. In addition, potential dangers of nuclear power plants stated by pre-service teachers are similar with the other studies such as Ateş and Saraçoğlu (2013) and Yıldırım and Örnek (2007). On the other hand, pre-service science teachers have views that nuclear energy is not a type of the clean energy. This shows that pre-service science teachers have misconception about clean energy concept since in related literature nuclear energy is also classified as clean energy (Eiden, 2013). Besides some of the pre-service science teachers stated that nuclear power plants may contribute to global warming due to releasing radiation. This is another misconception held by the pre-service science teachers. Similar result was found in the study done by Kılınç et al. (2013). The major reason of pre-service teachers to accept nuclear power plants is that it produces large amount of energy. In other studies (Driver, Stanisstreet & Boyes, 2010), students also emphasized the capability of nuclear power plants in terms of energy production. Overall, whereas pre-service social studies teachers supported the idea which is to have nuclear power plants in Turkey, a large part of pre-service science teachers offered to give primacy for alternative energy sources. Pre-service social studies teachers usually believe that nuclear energy has similar negative impacts on environment as much as other energy sources. For this reason, they support to be set up nuclear power plants in Turkey. Yet, pre-service science teachers advocate that nuclear energy is responsible for most of environmentally hazardous processes. That's why, they are not eager to have nuclear power plants in their country. On the other hand, Ateş (2013) concluded his study as pre-service science teacher support nuclear power plants. Although the participants in his study emphasize the similar negative impacts of nuclear power plants on environment and have similar views about nuclear power plants, they accept it owing to the fact that it is appropriate to produce too much energy.

As a consequence, it was reached in current research that although pre-service science teachers and pre-service social studies teachers have generally positive attitudes toward SSI, they have some major different views about nuclear power plants. Whereas pre-service social studies teacher have favorable views about having nuclear power plants in their country, pre-service science teachers hold negative views to setting up nuclear power plants. The reasons of this conclusion might be due to pre-service science teachers and pre-service social teachers have different backgrounds. For example, pre-service science teachers have more knowledge about scientific issues such as chemical reactions and waste; on the other hand, pre-service social teachers mainly have knowledge about economic productivity and usefulness. These different perspectives can give rise to have different views about setting up nuclear power plants. In other words, it can be said that this research enabled us to compare the scientific and the social views on the same socio-scientific issue, nuclear power plants. This research also allowed us to understand how pre-service science and pre-service social studies teachers defend their views whether they use scientifically valid data or not. It is indispensible fact that both groups of pre-service teachers hold superficial knowledge about nuclear power plants. That's why, they couldn't advocate their views with proper evidence.

Conclusion and Suggestions

Teachers are mainly responsible for educating their students as scientific literate and it is an indispensible fact that taking advantage of SSI has a vital role for scientific literacy. For this reason, pre-service teachers' attitudes toward SSI and examining how they support their views are important. In current research, it was found that SSI is an attractive for pre-service teachers but they also have some suspects about SSI implementations due to religion, moral and ethical perspectives. On the other side, their views about setting up nuclear power plants in their country was discussed with them in order to see what they think about this issue and how they support their views. It was reached that pre-service science and pre-service social studies teachers have different views about establishing nuclear power plants. Moreover it was concluded that they could not support their views with totally scientifically valid data. They usually used knowledge gathered from popular media, parents or friends. They did not present any valid scientific evidence, could not explain how nuclear power plants work and they usually used general expressions, which generally do not require formal education.



Based on the findings of the research, several suggestions can be done for curriculum designers and researchers. One of the suggestions can be that there should be courses in teacher education programs in order to discuss and learn about SSI, how to use argumentation during teaching and learning process. In addition, it should be investigated that which instructional method(s) might be more beneficial to develop attitude towards SSI. Moreover students' perspectives and views about SSI can be compared based on their age, region or grade level and, if any, possible reasons for the change in their attitudes should be investigated.

References

Ateş, H. (2013). Views of *pre-service science teachers about nuclear energy* (Master's thesis, Erciyes University). Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/tezSorguSonucYeni.jsp.

Ateş, H., & Saraçoğlu, M. (2013). Fen bilgisi öğretmen adaylarının gözünden nükleer enerji [Pre-service science teachers' perspective about nuclear energy]. *Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi (KEFAD), 14* (3), 175-193.

Bilen, K., & Özel, M. (2012). Gifted students' knowledge of and attitudes toward biotechnology. *Faculty of Necatibey Education Electronic Journal of Science and Mathematics Education, 6* (2), 135-152.

Boyes, E., & Stanisstreet, M. (1994). Children's ideas about radioactivity and radiation: Sources, mode of travel, uses and dangers. *Research in Science & Technological Education, 12* (2), 145-160.

Çokluk, Ö., Yılmaz, K., & Oğuz, E. (2011). Nitel bir görüşme yöntemi: Odak grup görüşmesi [A qualitative interview method: Focus group interview]. *Kuramsal Eğitimbilim, 4* (1), 95-107.

Demircioğlu, T., & Uçar, S. (2014). Akkuyu nükleer santrali konusunda üretilen yazılı argümanların incelenmesi [Investigation of written arguments about Akkuyu nuclear power plant]. *İlköğretim Online, 13* (4), 1373-1386.

Driver, L., Stanisstreet, M., & Boyes, E. (2010). Young people's views about using nuclear power to reduce global warming. *International Journal of Environmental Studies, 67* (1), 1-3.

Eastwood, J. L., Sadler, T. D., Zeidler, D. L., Lewis, A., Amiri, L., & Applebaum, S. (2012). Contextualizing nature of science instruction in socio scientific issues. *International Journal of Science Education, 34* (15), 2289-2315.

Eiden, T. J. (2013). Nuclear energy: The safe, clean, cost-effective alternative. *The Objective Standard, 8* (3). Retrieved from https://www.theobjectivestandard.com/issues/2013-fall/nuclear-energy-safe-clean-cost-effective/.

Kırbağ Zengin, F., Keçeci, G., & Kırılmazkaya, G. (2012). İlköğretim öğrencilerinin nükleer enerji sosyo-bilimsel konusunu online argümentasyon yöntemi ile öğrenmesi [Elementary school students learning about nuclear power plants with the online scientific argumentation learning program]. *E-Journal of New World Sciences Academy, 7* (2), 647-654.

Kılınç, A., Boyes, E., & Stanisstreet, M. (2013). Exploring students' ideas about risks and benefits of nuclear power using risk perception theories. *Journal of Science Education and Technology, 22* (3), 252-266.

Kind, P., Jones, K., & Barmby, P. (2007). Developing attitudes toward science measures. *International Journal of Science Education, 29* (7), 871-893.

Lewis, J., & Leach, J. (2006). Discussion of socio scientific issues: The role of science knowledge. *International Journal of Science Education, 28* (11), 1267-1287.

National Research Council (NRC). (1996). *National science education standards*. Washington, D. C: National Academy Press.

Özdemir, N. (2014). Sosyobilimsel esaslar çerçevesinde sosyobilimsel konuları tartışmak tutumları nasıl etkiler? Nükleer santraller [How will it affect attitudes to discuss socio-scientific issues within the framework of socio-scientific principles? Nuclear energy]. *Turkish Studies, 9* (2), 1197-1214.

Petit, P. (2013). France and Germany nuclear energy policies revisited: A veblenian appraisal. *Panoeconomicus, 60* (5), 687-698.

Ratcliffe, M. (1997). Pupil decision-making about socio-scientific issues within the science curriculum. *International Journal of Science Education, 19* (2), 167-182.

Reid, N. (2006). Thoughts on attitude measurement. *Research in Science and Technological Education, 24* (1), 3-27.

Sadler, T. D. (2004). Informal reasoning regarding SSI: A critical review of research. *Journal of Research in Science Teaching, 41* (5), 513-536.

Sadler, T. D. (2009). Situated learning in science education: Socio-scientific issues as contexts for practice. *Studies in Science Education, 45*, 1-42.

Sadler, T. D., & Zeidler, D. L. (2004). The morality of SSI: Construal and resolution of genetic engineering dilemmas. *Science Education, 88*, 4-27.

Sadler, T. D., & Zeidler, D. L. (2005). Patterns of informal reasoning in the context of socioscientific decision making. *Journal of Research in Science Teaching, 42* (1), 112-138.

Sönmez, A., & Kılınç, A. (2012). Preservice science teachers' self-efficacy beliefs about teaching GM foods: The potential effects of some psychometric factors. *Faculty of Necatibey Education Electronic Journal of Science and Mathematics Education, 6* (2), 49-76.

Şahin, F., & Hacıoğlu, Y. (2010, Kasım). Bilimsel tartışma destekli örnek olayların 8.sınıf öğrencilerinin "kalıtım" konusunda kavram öğrenmelerine ve okuduğunu anlama becerilerine etkisi [The effects of scientific argumentation on eighth grade students' learning the concept of "heredity" and reading skills]. *International Conference on New Trends in Education and Their Implications* (p. 11-13), Antalya, Turkey.

Topcu, M. S. (2010). Development of attitudes towards socio scientific issues scale for undergraduate students. *Evaluation & Research in Education, 23* (1), 51-67.
Topçu, M. S. (2015). *Sosyobilimsel Konular ve Öğretimi* [Socio-scientific issues and teaching]. Ankara: Pegem Akademi.
Topçu, M. S., Muğaloğlu, E. Z., & Güven, D. (2014). Socio-scientific issues in science education: The case of Turkey. *Educational Sciences: Theory & Practice, 14* (6), 14-22.
Yıldırım, M., & Örnek, İ. (2007). Enerjide son seçim: Nükleer enerji [Ultimate choice for energy: The nuclear energy]. *Gaziantep Üniversitesi Sosyal Bilimler Dergisi, 6* (1), 32-44.
Young, T. (1998). Student teachers' attitudes toward science (STATS). *Evaluation and Research, 12* (2), 96-111.
Zohar, A., & Nemet, F. (2002). Fostering students' knowledge and argumentation skills through dilemmas in human genetics. *Journal of Research in Science Teaching, 39* (1), 35-62.

Received: *August 23, 2016* Accepted: *October 28, 2016*

Hasan Ozgur Kapici	PhD Student, Research Assistant, Department of Science Education, Faculty of Education, Yildiz Technical University, 34220, Istanbul, Turkey E-mail: hokapici@yildiz.edu.tr
Genc Osman Ilhan	PhD, Research Assistant, Department of Social Studies Education, Faculty of Education, Yildiz Technical University, 34220, Istanbul, Turkey E-mail: gosman@yildiz.edu.tr

Copyright of Journal of Baltic Science Education is the property of Scientific Methodical Center Scientia Educologica and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.