Science Teachers' Views of Socio Scientific Issues

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Abstract

The aim of this study is to determine the awareness of science teachers about socio-scientific issues, the methods and techniques used in the teaching of socio-scientific issues, and the suggestions about effective teaching of socio-scientific issues. The sample of the study consisted of 75 science teachers (50 women, 25 men) who serve in various regions of Turkey. All participants answered the questionnaire consisting of open-ended questions. Afterward, interviews were conducted with 10 selected teachers. Content analysis was used to analyze the data. By the content analysis, it is aimed to reach the relations and concepts that can explain the collected data (Yıldırım and Şimşek, 2013). When the findings of the open-ended questionnaire were examined, it was determined that teachers did not associate the definition and content of the concept of the socio-scientific issue with science and they have a low level of awareness about the content. In addition, it was observed that the teachers mostly use the discussion method in the presentation of socio-scientific issues. Teachers also stated that the number of the outcomes included in the curriculum and number and diversity of socio-scientific issues in the textbooks are insufficient and they should be increased.

Keywords: Socio-scientific issue, science teacher, science education

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INTRODUCTION

Especially the scientific and technological developments experienced in the first quarter of the 21st century have had positive effects on people's living standards (Wu and Tsai, 2010). However, with the abuse of science and technology, many environmental problems that have a negative impact on human health have emerged (Christensen, 2007; Fortner, Lee, Corney, Romanello, Bonnel, Luthy, Figuerido and Ntsiko, 2000; Topçu, Sadler and Yılmaz-Tüzün, 2010). These problems have led to concerns among people, different ideas about the use of scientific and technological developments. This has led to many debates (Albe, 2008; Levinson, 2006). The issues involving these problems, which may occur in parallel with the scientific and technological developments, are called socio-scientific issues. Socio-scientific issues are the current issues that involve scientific and social issues together, contains many social dilemmas, have no definite answers, open to discussion, can be evaluated in many respects, cannot easily come to a conclusion, includes ethical issues in the eyes of society and concern society (Sadler, 2004; Sadler and Zeidler, 2005). Ratcliffe and Grace (2003) describe socio-scientific issues as technological issues with various social dimensions in which the values of ethics, morals, and beliefs of the society affect the decision-making and discussion of the advantage and disadvantages in a debate.

In recent years, many studies have shown that socio-scientific subjects are effective in contributing to science-literate individuals' growth, and therefore socio-scientific subjects should be included in science education programs appropriately (Hofstein, Eilks and Bybee, 2011; Sadler, 2003, 2004; Topçu, 2008; Walker and Zeidler, 2007; Zeidler and Keefer, 2003; Zeidler, Sadler, Simmons and Howes, 2005). With the inclusion of socio-scientific subjects in science education; science will gain more place in student's lives, they will find the opportunity to evaluate the ethical and moral relations of science and society (Pedersen and Türkmen, 2005; Sadler and Zeidler, 2004). Studies have shown that; socio-scientific issues can help students to contribute to decisions on local and global issues, understand the nature of science and gain experience to discuss controversial issues (Lee et al. 2013). Solving problems on a socio-scientific topic will encourage students to use scientific knowledge and socio-scientific issues in science education will be a tool to increase the priority of citizenship goals (Lee et al. 2012).

To be able to process the science course in the desired quality, students need to be active in their learning environments and teachers should be good guides (MEB, 2013). Students are encouraged to discuss socio-scientific topic-based learning in learning environments, and they have the opportunity to develop their high-level skills such as critical thinking, questioning and argumentation by presenting their feelings and thoughts within the framework of these discussions (Osborne et al. 2004; Sadler and Zeidler, 2005; Zohar and Nemet, 2002). Science literate individuals should have scientific knowledge in the socio-scientific situations concerning the society and the level of science-technology-society relations in the society they live in and should be able to comment on these issues and be involved the decision-making process (Çavuş, 2013; Holbrook and Rannikmae, 2007; Osborne and Dillon, 2008). This will only be possible by including socio-scientific subjects in the curriculum and by learning the socio-scientific subjects (Lee, Abd-EI-Khalick and Choi, 2006; Lumpe, Haney and Czerniak, 1998;). In order to teach socio-scientific subjects effectively, in addition to take part in the curriculum and to know how to teach, the teacher who is going to teach these issues should have some features. Presley et al. (2013) believe that teachers who will teach socio-scientific subjects should have the following characteristics: 1) have sufficient content knowledge of the socio-scientific issue, 2) be aware of the social dimensions of the subject, 3) be honest about their own knowledge level about the socio-scientific issue, 4) should be willing to contribute to knowledge rather than to become a person of authority on the relevant socio-scientific issue, 5) be prepared and willing in advance against the uncertainties that may arise during the teaching of the socio-scientific issues (Topçu, 2015). Teachers can contribute to the effective teaching of socio-scientific issues only when they are aware of socio-scientific issues and social impacts of socio-scientific issues (Presley et al. 2013; Sadler et al. 2006). It has seen that the studies done about socio-scientific issues with teachers are mostly; teachers' awareness of socio-scientific issues, their personal interest in socio-

scientific subjects, value judgments, and their influence on teaching socio-scientific issues (Clakeburn, Downie and Matthew, 2002; Lazarowitz and Bloch, 2005; Lee and Witz, 2008; Sadler et al. 2006).

Teachers provide guidance to students in learning-teaching environments. The teacher is responsible for the regular execution of learning-teaching process. The realization of an effective learning-teaching process is only possible with teachers who have high knowledge and awareness. Since the aim of science teachers is to educate individuals who will shape the future of society with knowledge and awareness about socio-scientific issues, teachers themselves should have knowledge and awareness about socio-scientific issues (Sadler, 2004). Therefore, it is important to determine the awareness of teachers who train students on socio-scientific subjects.

In this study, it is aimed to determine the awareness of science teachers about socio-scientific issues, methods and techniques used in the teaching process of socio-scientific issues and their suggestions about effective teaching of socio-scientific issues.

METHOD

Research Model

In this study, a holistic single case study has been used, which is one of the qualitative research designs. In a holistic single-case study, the researcher aims to examine in depth the same issue, but the views of individuals in different environments (Baxter & Jack, 2008; Stake, 1995). In this study, the opinions of science teachers about teaching of socio scientific issues were examined.

Participants of the Research

In the research, appropriate sampling method was used as one of the random sampling methods. According to this sampling method, the sample is selected from easily accessible units in terms of time, cost and labor. The demographic information form used to collect data and the opinion form on socio-scientific issues was prepared by the researchers through Google Surveys. The forms were shared online through social media platforms for teachers.The sample of the study consisted of 75 science teachers (50 women, 25 men) who serve in various regions of Turkey. When the seniority of the participants is analyzed, it has seen that there are 47 teachers between 1-5 years, 19 teachers between 6-10 years and 9 teachers between 11-15 years. Also it is seen that 60 of the teachers (80%) are bachelors and 15 of them (20%) have master's degree. When the courses about socio-scientific issues taken during the undergraduate education of the participants were examined, it has seen that; 47 teachers (%62) stated that there were socio-scientific issues in the course content, 17 teachers (%23) stated that they did not have any socio-scientific issues in the course content and 9 teachers (%12) stated that they did not remember whether there was a socio-scientific subject in the course content. 2 teachers (%3) did not answer the question.

Data Collection Tools

All participants answered the questionnaire consisting of open-ended questions. In order to obtain more in-depth information about the data obtained from the open-ended questionnaire, interviews were conducted with 10 teachers selected among the participating teachers using the criterion sampling technique. As criteria; gender, seniority and education level were taken into consideration.

Questionnaire

The questionnaire consists of three open-ended questions. The questions in the questionnaire include the teachers' ideas about the socio-scientific issues, which methods and techniques they use in

the teaching of socio-scientific issues and their suggestions for better teaching of the socio-scientific issues. The validity and reliability studies of the developed questionnaire were made opinions of five field experts (1 physics educator, 1 chemistry educator, and 3 science educators). Then, the pilot study of the questionnaire was made with 10 teachers and the final version of the survey was given to the survey. In the questionnaire, the following open- ended questions were asked in order to get information about the socio-scientific subjects of the teachers:

1. What do you think about the socio-scientific subject? Can you explain that?

2. Which methods and techniques do you prefer to use in the teaching of socio-scientific subjects to students? Why is that?

3. How do you think socio-scientific issues can be used effectively in the science course?

Semi-structured interview

After the open-ended questionnaire was applied to 75 science teacher, a semi-structured interview was conducted with 10 teachers (5 males, 5 females) randomly selected from the sample. When the seniority of the teachers interviewed is examined it has seen that 3 of the teachers interviewed have 1-5 years, 4 of them are 6-10 years and 3 of them have 11-15 years of professional experience. In the interviews, the following questions were asked in order to get more in-depth information about the socio-scientific subjects of the teachers:

1. What comes to your mind, when we say what is a socio-scientific issue? Can you explain it?

2. Which methods and techniques do you prefer to use for teaching socio-scientific issues to students? Why?

3. How can socio-scientific issues be used effectively in the science course?

Interviews with each teacher took 20 minutes. Interviews were recorded and transcribed with a voice recorder.

Data analysis

The three open-ended questions in the questionnaire developed by the researcher were prepared to determine the awareness of the science teachers about socio-scientific issues, the methods, and techniques used in the teaching process of socio-scientific issues, and their suggestions about effective teaching of socio-scientific issues. The questionnaire was applied to 75 science teachers. Participant teachers were coded as T1, T2, ... T74, T75. Content analysis was used to analyze the data. By the content analysis, it is aimed to reach the relations and concepts that can explain the collected data (Yıldırım and Şimşek, 2013). In accordance with the answers received from the participants, the codes were made and presented in tables. In addition, interpretations related to each table and direct quotations are given in order to reflect the views of the participants. One-to-one citations from codes and categories obtained from the teachers' opinions are made in order to ensure validity. To ensure the reliability of the study, the researchers coded the data obtained separately. By comparing the coding of the two researchers independently, appropriate expressions were selected from similar coding.

The interviews were carried out with 10 science teachers who were selected from science teachers who answered the questionnaire. Interview participants were coded as O1, O2, ..., O10. After the breakdown of the interviews, the coding process was made according to the concepts and expressions that the data defined or recalled around the problem and sub-objectives of the research.

Interview breakdowns are indexed by line-by-line and divided into categories (Glesne, 2012). While reading the data, the concepts and words that data recalled and presented were noted. It has been determined that the resulting codes fit into the correct frameworks under appropriate themes in relation to the themes created in accordance with the sub-problems of the research.

In order to ensure the reliability of the research, the researcher and an expert faculty member were compared with each other by making separate codings simultaneously. Reliability was calculated by using Miles and Huberman's formula to reveal the consensus and disagreement between the researcher and the faculty member who made the coding. In qualitative studies, it is desirable that the compatibility between the codings carried out independently of each other be above 70% (Yıldırım and Şimşek, 2008). In this study, it was seen that there was a 90% consensus among the coding.

FINDINGS

Definitions of teachers related to socio-scientific issue

In this section, the opinions of the science teachers about the definition of the concept of socio-scientific issue are given. The participants' opinions are presented in Figure 1.

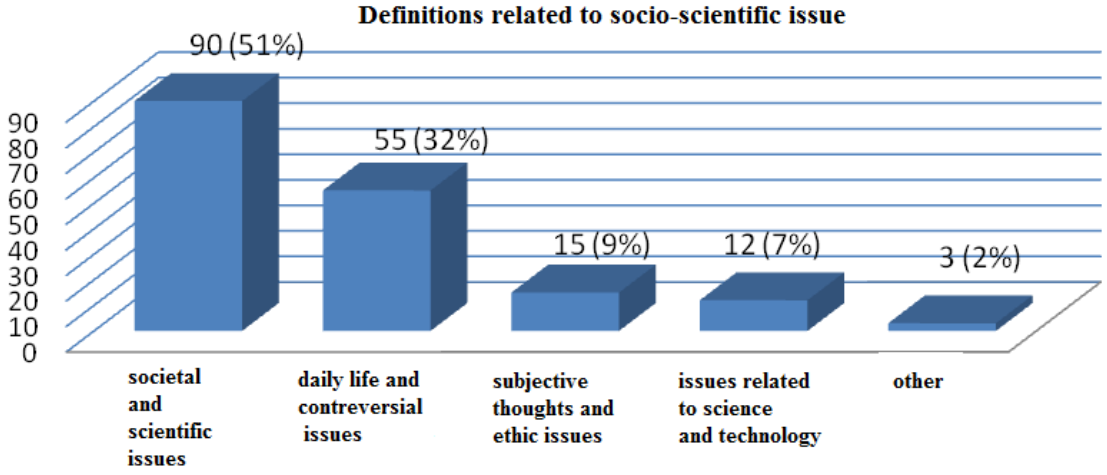

Figure1. The definitions of science teachers about a socio-scientific issue

*A teacher has more than one answer to this question.

Most of the participants describe socio-scientific issues as the subjects in which social problems interact with science, be in social life, which tries to determine the thoughts of people about certain subjects and associate them with society.

Teachers (50%) who define the concept of socio-scientific issues as “societal and scientific issues” appear to express their opinions as follows.

T13: "researching, developing and searching for solutions of the issues related to society with gathering science”

Teachers (%32) who define the concept of a socio-scientific issue as “everyday life and controversial issue” appear to express their opinions as follows.

T72: " Socio-scientific issues are controversial, with no definitive answer, and are the subjects of personal beliefs and values that are the subject of daily life.”

Teachers (9%) who describe socio-scientific issues as "ethical issues and contain subjective thoughts" appear to express their opinions as follows:

T66: "when an individual deciding on a subject have to decide on the social side of this decision, considering the moral and ethical aspects".

Teachers (%7) who define the concept of socio-scientific issue as "issue related to science and technology" appear to express their opinions as follows.

T52 " To make the daily life topics related to science to be included in the curriculum"

The findings of the answer to the question "What comes to your mind, when we say what is a socio-scientific issue? Can you explain it?" asked in the interview are presented in Table 1.

Table 1. Definitions of participants about socio-scientific issue

Definitions	Teacher Codes	Frequency
Scientific subject	O1, O2, O3, O4, O5, O6, O7, O9, O10	9
Controversial issue	O1, O2, O3, O4, O8, O9, O10	7
Societal issue	O1, O3, O5, O8, O10	5
Ethical issue	O1, O4, O7, O8, O9	5
Social subject	O1, O3, O4, O6, O7	5
Subjectivity	O1, O3, O7, O9, O10	5
Environment issues	O2, O6, O10	3
Cultural issue	O3, O4, O7	3
Current issue	O1, O2, O9	3
Issue related to science and technology	O10	1

When the interviews were analyzed, it has seen that most of the participants defined the concept of the socio-scientific issues as a scientific subjects. In Table 1, examples of the opinions of teachers who define the concept of a socio-scientific issues as a scientific subjects are presented below.

O1: ".... be scientific that meant the subject is science-related, scientifically verified "

The example of the teachers who define the concept of socio-scientific subject as a controversial issue in Table 1 are presented below.

O4: " these issues are complex and leave people in dilemmas. So they cause an instability "

In Table 1, example of the opinions of teachers who define the concept of a socio-scientific issues as a social issue are presented below.

O8: "I think there are issues related to society, such as diseases, think tuberculosis in our age is still a problem in our lives, so if there must be a problem in tuberculosis vaccine".

The example of the teachers who define the concept of a socio-scientific issue as an ethical issue in Table 1 are presented below.

O1: "In short, these are open-ended issues, these issues have situations related to human moral aspects. In other words, if we give an example of nuclear energy, for example, many people look at the phenomenon as a material financial power, looks energy is important but does not take into account the negative situation for environment, but some people think opposite, thinks living space, future at first, put the material on the background and opposes the construction of a nuclear power station.

The example of the teachers who define the concept of socio-scientific subject as a social subject in Table 1 are presented below.

O7: "...As a result of natural interaction, there have been situations related to social life related to social developments. These situations which directly affect social life are evaluated in different ways by different sections of society.

The example of the teachers who define the concept of socio-scientific subject as subjectivity in Table 1 are presented below.

O7: "...As a result of natural interaction, there have been situations related to social life related to scientific developments. These situations which directly affect social life are evaluated in different ways by different sections of society.

The example of the teachers who define the concept of socio-scientific subject as an environmental issues in Table 1 are presented below.

O6: "……. problems are emerging like diseases or environmental problems, scientists are working to solve these problems using science ".

The example of the teachers who define the concept of socio-scientific subject as a cultural issues in Table 1 are presented below.

O7: "The approach of society to socio-scientific issues is not always with a scientific point of view. This leaves question marks in mind. opposite to these situations reflexes is often based on belief and culture.

The example of the teachers who define the concept of socio-scientific subject as a current issue in Table 1 are presented below

O2: "It is a combination of scientific information and the subjects that are experienced before or experienced in daily life.

The example of the teachers who define the concept of socio-scientific subject as Issue related to science and technology in Table 1 are presented below

O10: " is more related to fields science, society, technology"

The methods and techniques that teachers prefer to use in the teaching of socio-scientific issues

In this section, the methods and techniques that teachers prefer to use in the teaching of socio-scientific issues. Participant opinions are presented in Table 2.

Table 2. Methods and techniques used for teaching socio-scientific issues

Method and technical themes	Method and technical codes	Frequency	Total
Group Teaching Techniques	Brainstorming	16	60
	Question-answer	9	
	Six thinking hats	9	
	Drama	9	
	Teamwork	5	
	Experiment	5	
	Theater	2	
	Scenario creation	2	
	Analogy (simulation)	2	
	Six shoes	1	

Discussion Method	Discussion	27	37
	Debate	8	
	Argumentation	2	
Out of class teaching techniques	Research homework	21	23
	Travel- observation	1	
	Outdoor learning	1	
Instruction Method	Presentation- instruction	17	17
Other	Video track	10	12
	Discovery method	2	
Problem-solving method	Problem-solving	5	5
Case study method	Case study	5	5
Project method	Project Preparation	5	5

In Table 2, it has seen that science teacher stated that they mostly use the group teaching techniques in the teaching of socio-scientific issues, then the discussion method, out-of-class teaching techniques, instruction method, problem-solving method, case study method, and project method.

It has seen that 16 science teachers specify brainstorming from group teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T22:" We do studies such as discussion and brainstorming. These techniques allow students to express their ideas clearly".

It has seen that 9 science teachers specify question and answer techniques from group teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T61 : "If the students hear some socio-scientific issues from TV, I open up a discussion based on their knowledge. If there is a text on the subject in the textbooks, I ask them what is told. Then I want students to offer solutions about this issue

It has seen that 9 science teachers specify six thinking hats technique from group teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T65: "I use six thinking hats on environmental issues and global warming. This technic provides students; to have positive and negative information about our life, our world, our future, our health and having alternative solutions for environmental problems and be sensitive.

It has seen that 9 science teachers specify drama techniques from group teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T68: "We taught these situations to the children through drama activities. Thus, the student is able to reveal his feelings and thoughts more easily".

It has seen that 27 science teachers specify discussion techniques from discussion techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T29:" With the help of discussion method multivocality is provided in the classroom, different opinions are raised, negative and positive aspects are analyzed, and student's affective properties such as empathy and respect are also developed".

It has seen that 8 science teachers specify debate techniques from discussion techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T40: "I'm using the debating technique. Make a group of students who say should be / should be done and make a group of students who should not be / should not be done and let them discuss with their reasons".

It has seen that 21 science teachers specify research homework from out of class teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T12: "I make students do more research. By this, I provide them to remove their curiosity in my control."

It has seen that 17 science teachers specify presentation- instruction from out of instruction method in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T11: "Generally the method of presentation. Unfortunately, we cannot concentrate too much because children are tired of teog exam, or because the learning outcomes are at the end of the school"

It has seen that 5 science teachers specify problem-solving from problem-solving method in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T67: "Visual and interactive method techniques. Solution-oriented method techniques, visual training presentations, problem-solving method"

It has seen that 5 science teachers specify case study from case study method in teaching socio-scientific issues. Example of teachers' expressions are presented below.

T62:"Humans are social beings. Socio- scientific studies can affect people immediately. That's why I take care of giving examples from everyday life, use case study method".

It has seen that 10 science teachers specify video track another category in teaching socio-scientific issues. Example

s of teachers' expressions are presented below.

T63: "…We transfer the places we could not go and the socio-scientific events that we could not examine by videos, posters, etc".

The findings of the answer to the question "Which methods and techniques do you prefer to use for teaching socio-scientific issues to students? Why?" asked in the interview are presented in Table 3.

Table 3. Methods and techniques used in the instruction of socio-scientific issues

Method and technical themes	Method and technical codes	Frequency	Total
Discussion Method	Discussion	10	19
	Debate	7	
	Argumentation	2	
Group Teaching Techniques	Six thinking hats	5	12
	Brainstorming	4	
	Question-answer	1	
	Scenario creation	1	
	Station teaching method	1	
Other	Video track	4	9
	Poster presentation	4	
	Slideshow	1	
Out of class teaching techniques	Research homework	7	7
Instruction Method	Presentation- instruction	3	3

In Table 3, it has seen that science teacher stated that they mostly use the discussion method in socio-scientific subjects and then they use group teaching techniques, other techniques, out-of-class teaching techniques, instructional methods.

It has seen that 10 science teachers specify discussion techniques from discussion techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O5: "I mostly use the discussion method often because it is appropriate to the topics and the topics are controversial. Every student can say his/her opinion freely".

It has seen that 7 science teachers specify debate techniques from discussion techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O3: "...I show a story about case study in the classroom environment and make students express their thoughts on this topic. We are debating more and we put forward different ideas".

It has seen that 9 science teachers specify six thinking hats technique from group teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O9:"... Six hat thinking techniques. I think this method is appropriate because socio-scientific issues contain open-ended questions and many uncertainties".

It has seen that 4 science teachers specify brainstorming from group teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O4: "I mostly use the discussion method, discussion techniques changes according to the issue. For example, I use debate, brainstorming techniques".

It has seen that 4 science teachers specify video track from another category in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O9: I'm trying to watch videos and make discussions about this video. When issues related to social life come, I endeavor to stay on it. Sometimes I watch videos about these subjects documentary at the school, and I emphasize that students should be sensitive about these issues.

It has seen that 4 science teachers specify poster presentations from another category in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O8: "Last week we prepared a poster about dialysis. I wish I could take the children to a dialysis center".

It has seen that 7 science teachers specify research homework from out of class teaching techniques in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O4: "I give research homeworks, prepare presentations, make poster works. I prefer to use them more because the issues are controversial, in this way I give opportunity to students to express themselves and their different opinions. I give research homeworks by this way they search on the subject themselves to get information"

It has seen that 3 science teachers specify presentation-instruction techniques from the instructional methods in teaching socio-scientific issues. Example of teachers' expressions are presented below.

O5: "Sometimes I use the presentation method. When I have time problems, it is more attractive to tell the lesson through the slide".

Recommendations for making socio-scientific issues more effective in the teaching process

In this section, the suggestions of science teachers about socio-scientific issues that can be done about making the teaching process more effective are included. Participants' opinions are presented in Table 4.

Table 4. The Opinions of science teachers on what kind of arrangements can be made about socio-scientific subjects in the curriculum

Themes	Teacher Opinions	Frequency (f)	
The scope of socio- scientific issues	Learning outcomes about socio-scientific issues should be increased	14	39
	More socio-scientific issues should be included into textbooks	13	
	Time allocated for socio-scientific issues should be increased	7	
	The number of socio-scientific issues should be increased	3	
	Activities related to socio-scientific issues in textbooks should be increased	2	
Position of socio-scientific issues	Socio-scientific issues can be added as an elective course	4	14
	Socio- scientific issues can be handled as a seperate unit	2	
	Positive and negative aspects of scientific knowledge should be considered	2	
	Socio-scientific issues should be addressed at the end of the units	1	
	Socio-scientific issues should be put forward in unit rankings	1	
	Current, interesting topics should be addressed	1	
	Socio-scientific issues must be associated with values education	1	
	The program should prepare for life and should direct to scientific thinking	1	
	Socio-scientific issues should not contradict with culture	1	
Teaching of socio-scientific issues	Activities related to socio-scientific issues should be enriched/regulated	10	28
	Research should include discussion-based regulations	4	
	There should be guidance/ books for teaching subjects	3	
	Debate activities should be added to the textbooks	3	
	Out-of-school studies should be included	1	
	Laboratory activities should be increased	1	
	Collaboration should be done with universities	1	
	Teaching materials should be enriched	1	
	A web site can be made for socio-scientific issues	1	
	There should be explanatory information about socio-scientific teaching	1	
	Seminars should be given to students for socio-scientific teaching	1	
	Problem based learning should be used for teaching scio-scientific issues	1	
Other views	I don't think any editing will be made for teaching of socio-scientific issues	1	6
	Arrangements should be made for the needs	1	
	People quality need to change rather than the curriculum	1	
	Socio-scientific subjects should be associated with all courses	1	
	Teachers can be encouraged for graduate education	1	
	I think it's enough	1	

In Table 4, the proposals that could be made in the curriculum were collected under the themes of "the scope of socio-scientific issues", "position of socio-scientific issues", "teaching of socio-scientific issues" and "other views".

Example of teachers' expressions in the category of the scope of socio-scientific issues as increasing the learning outcomes are presented below.

T4: "So you see that the curriculum is exam-oriented. There are just a few learning outcomes related to socio-scientific issues or there are one or two issues in the textbook, the issues that should be present in the textbook are not there or that have already existed with little information. I think the learning outcomes related to the socio-scientific issues should be increased.

Example of teachers' expressions in the category of the scope of socio-scientific issues as more socio-scientific issues should be included in textbooks are presented below.

> *T2: "More socio-scientific issues should be included, the content should be increased. Activities are minimal and content is empty for me, so they should be enriched and reproduced, teaching method techniques should be enriched.*

Example of teachers' expressions in the category of the scope of socio-scientific issues as time allocated for socio-scientific issues should be increased are presented below.

> *T54: "More space and time can be given to these issues in the curriculum".*

Example of teachers' expressions in the category of the position of socio-scientific issues as socio-scientific issues can be added as an elective course are presented below.

> *T74: "As the socio-scientific issues changes by the time, there should be an elective course for socio-scientific issues …"*

Example of teachers' expressions in the category of the position of socio-scientific issues as socio-scientific issues can be handled as a separate unit are presented below.

> *T47: "I think it could be handled as a separate unit. Normally, these issues are located at the end of the term so the unit can not be taught. Rather than taking place at the end of the unit, a unit consisting of socio-scientific issues can be organized as a final unit, dealing with the topics covered by the year".*

Example of teachers' expressions in the category of the position of socio-scientific issues as positive and negative aspects of scientific knowledge should be considered are presented below.

> *T59: "We can give positive and negative situations together and these situations will lead students to think."*

Example of teachers' expressions in the category of the teaching of socio-scientific issues as activities related to socio-scientific issues should be enriched/regulated are presented below.

> *T41: "Science curriculum should be dynamic, renewed, scientific topics in the ever-changing world should be followed and be included in the program. The activities related to socio-scientific and social issues in textbooks are insufficient and the contents are not rich. These activities should be improved and be more useful"*

Example of teachers' expressions in the category of the teaching of socio-scientific issues research should include discussion-based regulations are presented below

> *T49: "Since socio-scientific issues are more controversial, the nature of the curriculum should be compatible with the debate. In the program, activities and learning outcomes that will allow research and discussion should be formed and textbooks should be prepared"*

Example of teachers' expressions in the category of the teaching of socio-scientific issues as there should be guidance/ books for teaching subjects are presented below.

> *T48: "Additional books on these topics can be placed next to the textbook. These additional books may contain information on how to handle topics."*

Example of teachers' expressions in the category of the teaching of socio-scientific issues as debate activities should be added to the textbooks are presented below.

Ö36: "First, socio-scientific issues can be given more weight. Activities like discussion can be put on the textbooks"

The findings of the answer the question "How can socio-scientific issues be used effectively in the science course?" asked in the interview are presented in Table 5.

Tablo 5. The opinions of science teachers on what kind of arrangements can be made about socio-scientific subjects in the curriculum

Themes	Teacher Opinions	f
Recommendations on the integration of socio-scientific subjects into the curriculum	Guidebooks and activity books on the teaching of socio-scientific issues can be written	5
	More socio-scientific issues should be included into textbooks	3
	More socio-scientific issues should be included into the curriculum	2
	Socio-scientific issues can be added as an elective course	2
	Socio- scientific issues can be handled as a separate unit	1
	The number of courses should be increased in schools	1
	Textbooks should be prepared by experts	1
	A web site can be made for socio-scientific issues	1
	Materials related to socio-scientific issues should be enriched	1
	Seminars should be given to students for socio-scientific teaching	1
Recommendations for teachers	Teachers should be supported on socio-scientific issues and their teaching	7
	Teachers should have knowledge about socio-scientific issues	5
	Teachers should read scientific publications about socio-scientific issues	4
	Teachers must do postgraduate education	3
	Teachers must be a researcher	2
	Teachers should prepare sample activities and share them with their colleagues	1

In the category of recommendations on the integration of socio-scientific subjects into the curriculum, it has seen that 5 science teachers expressed their opinions as increasing the learning outcomes about socio-scientific issues. Example of teachers' expressions are presented below:

O2: "But first teachers should be aware of socio-scientific issues. I think guide books should be prepared about how do the socio-scientific issues can be taught"

In the category of recommendations on the integration of socio-scientific subjects into the curriculum, it has seen that 3 science teachers expressed their opinions as more socio-scientific issues should be included in textbooks:

O5: "...More activities should be included in the textbooks on socio-scientific issues rather than theoretical knowledge."

In the category of recommendations on the integration of socio-scientific subjects into the curriculum, it has seen that 2 science teachers expressed their opinions as more socio-scientific issues should be included in the curriculum:

O3: "In order for socio-scientific subjects to take an effective place in the curriculum, new approaches should be included in the curriculum".

In the category of recommendations on the integration of socio-scientific subjects into the curriculum, it has seen that 2 science teachers expressed their opinions as Socio-scientific issues can be added as an elective course

O5: "There are few learning outcomes about socio-scientific subjects in the curriculum. Elective courses related to these socio-scientific subjects can be placed in the 5th or 6th grade".

In the category of recommendations for teachers, it has seen that 7 science teachers expressed their opinions as teachers should be supported on socio-scientific issues and their teaching:

O6: "Seminars should be given to teachers on socio-scientific issues. The content of the curriculum should be more detailed, and I think the scope of some of the achievements is not clear. The teacher should know how to teach these topics. Tteaching methods and techniques should be enriched. These subjects should be added to the lesson plans"

In the category of recommendations for teachers, it has seen that 5 science teachers expressed their opinions as teachers should have knowledge about socio-scientific issues:

O5: "The teacher should have knowledge of the subject area and should develop and constantly renews himself about these issues"

In the category of recommendations for teachers, it has seen that 4 science teachers expressed their opinions as teachers should read scientific publications about socio-scientific issues:

O8:" I think a science teacher should continuously investigate, should approach with doubt to everything, a science teacher read continuously ."

CONCLUSION AND DISCUSSION

In our age, where science and technology are developing rapidly, the need for scientific literacy requires much more importance in socio-scientific issues in our education systems. Students should have knowledge about socio-scientific issues, be able to discuss, to be able to find solutions to the problems they face in real life. Teachers, who are the people who will guide students in gaining these skills, should have their own awareness of socio-scientific issues. The assumptions, beliefs, values, prejudices, preferences, and educations of the social and cultural circles of the scientists greatly affect what kind of problems they are pursuing, what kind of questions they ask, what they observe (and what they do not observe). For this reason, determining the opinions and values of science teachers about socio-scientific issues will reflect how they carried out the teaching of these subjects.

Making socio-scientific issues as a part of the education system is important in questioning the values of the teachers and students in the system and developing the missing values. For this reason, firstly, it was tried to determine the thoughts of teachers about the concept of the socio-scientific issues. In the related literature socio-scientific issues are mentioned as; the controversial subjects (Sadler and Zeidler, 2005), which contain both scientific and social issues at the same time (Sadler, 2004), whose content is meaningful and important in social life, has no definite answer, contains dilemmas, and has ethical and moral side (Sadler, 2009; Topçu, 2011). It is seen that the participants defined the concept of socio-scientific subject mostly as societal and scientific, daily life and controversial subjects. It is seen that the frequency of expressing the personal, political and ethical dimensions of the socio-scientific issues by the participants is low (Tidemand and Nielsen, 2017). When the answers of the participants to the interview question are examined, it has seen that they mostly define the socio-scientific issue concept as scientific, controversial and societal subjects and at least the subjects related to science and technology. The socio-scientific issue must present a problem related to science and should be a problem related to society (Sadler, Foulk and Friedrichsen, 2017). The two important features of socio-scientific issues in the key role are that they are related to science and have social importance (Eastwood et al. 2012). However, it is generally seen that socio-scientific subjects are not associated with science and technology but are stated as controversial, societal and scientific issues. This situation can be explained by the fact that the participant teachers do not associate the definition and content of the concept of socio-scientific issues with science and have a low level of awareness about the content.

The strategies used in teaching socio-scientific subjects vary according to situations. Personal values and thoughts or the educational aims of the teacher are located as a motivating force. In addition, if teachers believe in the importance and necessity of teaching socio-scientific issues, they constantly develop and motivate themselves in line with their objectives. It has seen that teachers

stated that they mostly use group teaching techniques in the teaching of socio-scientific issues, then they use the discussion methods, out of class teaching techniques and instruction methods. In addition to the many characteristics of socio-scientific issues, teaching should be conducted within the framework of controversial social issues. Since socio-scientific issues contain controversial issues, it is thought that the discussion technique, which is frequently used by the participants, is preferred because it is appropriate for the nature of socio-scientific issues. According to the science teachers, the discussion technique has benefit as students are exposed to more than one perspective in the development of social skills, trust and communication skills, personal opinions and thinking skills. It has seen that the most important reason for the teachers to choose the discussion method is that the students can analyze the positive and negative aspects of the subject by presenting different opinions in the classroom. However, in the in-depth interviews, it was found that some of the teachers were worried about how to organize the class and provide an appropriate discussion environment when using the discussion technique in the classroom. Particularly, it has seen that there is a very low number of teachers who talk about an argumentation process that is appropriate for the nature of socio-scientific issues and carries this process to their classes. It is known that the knowledge and application skills of the participants are insufficient for the place of socio-scientific issues in the classroom (Han Tosunoğlu and İrez, 2017). Another method used by the participants in the teaching of socio-scientific issues is the presentation-instruction method. In the interviews, it was observed that teachers frequently used this method in the teaching of socio-scientific issues due to the anxiety to complete the curriculum and lack of material. In addition, it has been revealed that activities to teach socio-scientific issues are mostly made to increase the students' motivation towards courses and to increase the permanence of the information to be taught by the audio and visual materials used. At this point, it can be said that teachers can not teach socio-scientific issues proper to the purpose. It can be said that the methods and techniques used by the science teachers who participated in the study in order to teach the socio-scientific subjects included constructivist teaching understanding as well as traditional teaching. Sıbıç (2017) has reached a similar conclusion in the study called "Science teacher candidates' views on socio-scientific issues and socio-scientific subject-based teaching". The adoption of the constructivist approach in a significant part of the methods and techniques used by teachers in socio-scientific issues is in conformity with the approaches in the literature that should be adopted in teaching socio-scientific issues (Albe, 2007; Sadler, 2009; Sadler and Zeidler, 2004; Topçu, 2008). Akşit (2011) stated that the methods and techniques used by the primary school teacher candidates in the teaching of socio-scientific subjects are; creative drama, using visual materials, the project method, to carry out joint studies with the families, to provide learning by doing and experiencing, to organize trips about the problems and to invite the experts to the school. It can be said that pre-service teachers more adopt the constructivist approaches than teachers doing the profession. This situation is thought to be caused by disadvantaged situations encountered by teachers in the field. Considering the related literature, it is observed that because of some obstacles that teachers avoid to teach discussing subjects in their classrooms. These obstacles are; teachers think that they may have problems in the classroom management, they have concerns about not being able to complete the topics covered by the curriculum, the inadequacy of the materials to be used in teaching of the subjects and the issues in the curriculum are criticising the state policies (Cross and Price, 1996; Day and Bryce, 2011; Gayford, 2002; Lee et al. 2006). Activities, seminars, and projects should be done to increase the knowledge and practice levels of teachers about different methods and techniques such as argumentation, discussion, drama, six hats, and brainstorming. It should be ensured that teachers transfer the knowledge they have gained on the subject correctly to the student.

In 2013, socio-scientific subjects were included in the new science curriculum with the renewal of the science curriculum in Turkey. Socio-scientific issues take place in the scope of the science-technology-society-environment learning area in the new program. One of the main aims of the science curriculum is to improve students' scientific thinking habits by using socio-scientific issues (MEB, 2013). In addition, socio-scientific issues in the science curriculum include scientific and ethical thinking skills for solving socio-scientific problems related to science and technology. Apart from these, it has seen that other statements about socio-scientific issues are included in the science curriculum.

Similarly, teachers stated that the number of the outcomes included in the curriculum and number and diversity of socio-scientific issues in the textbooks is insufficient and they should be increased. It has seen that in the interviews, teachers pointed out the importance of the socio-scientific issue and their teaching. They also stated that the fact that these important issues were too little in the current program would cause the main objectives of the program not to be realized. Critical thinking and the use of scientific mind habits that we frequently use when deciding on socio-scientific issues are two important features of science literacy. Because of this, science literacy interacts with socio-scientific issues (Sürmeli 2008; Topçu, Muğaloğlu and Güven, 2014; Zeidler and Keefer, 2003). Considering the importance of socio-scientific issues in terms of being a science-literate individual, it is thought that more places should be given to these issues in the curriculum. There are similar studies in the literature. For example, Polat et al. (2012) in their study of teachers working in certain areas of Turkey's, one of the recommendations is that more space should be given to socio-scientific issues in the curriculum.

According to Toraman and Alçı (2013)'s study done for determining the views of science and technology teachers on the renewed science curriculum, new program has more socio-scientific issues then compared to science and technology program (Toraman and Alçı 2013). Another suggestion expressed by the participants is that there should be an elective course under the name of socio-scientific issues. In the interviews, the teachers stated that the number of natural sciences courses is not sufficient for the outcomes other than socio-scientific issues and enough time can't be given for socio-scientific issues and therefore it can be taught as an elective course. When some studies about socio-scientific issues are examined, it has seen that teachers have problems related to time in teaching socio-scientific issues in classrooms (Saunders and Rennie, 2013). It is thought that this time problem can only be solved by giving place to socio-scientific issues under different course content. Teachers' suggestions include the enrichment of activities related to socio-scientific issues in the current textbooks and publication of guide books for teaching socio-scientific issues. During the interviews with the teachers, they stated that there is no course material on how to teach socio-scientific issues and that the current textbooks only touch on these issues in one text. It is obligatory to have course materials that can help teachers with the teaching of socio-scientific subjects. Levinson and Turner (2001) also stated that one of the problems experienced by teachers about socio-scientific issues is the lack of material. The problem of lack of material for teaching socio-scientific issues directs teachers to transfer their knowledge of socio-scientific subjects to the students. This situation prevents the realization of proper education for the content of socio-scientific issues. Teachers need to use different methods and techniques when processing socio-scientific subjects in the classroom. There isn't any information on the teaching of socio-scientific issues in the science curriculum. The methods and techniques to be used in the teaching of socio-scientific issues are directly left to the teacher. It is not questioned what the teacher's knowledge and experience are in practice. It is seen that teachers do not have enough knowledge about how to apply the methods and techniques to be used in the effective teaching of socio-scientific issues.

Note: This study is a part of Olgun Demir's master thesis (Demir, O. (2019). Fen Bilimleri Öğretmenlerinin Sosyo-Bilimsel Konular ve Bu Konuların Öğretimine Yönelik Görüşlerinin İncelenmesi [The aim of this study is to determine the awareness of science teachers about socio-scientific issues, the methods and techniques used in the teaching of socio-scientific issues, and the suggestions about effective teaching of socio-scientific issue]. (Unpublished master's thesis). University of Karadeniz Technical, Trabzon.

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