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Science teachers' opinions on socio-scientific issues

Hanife Fani [1*], Institute of Educational Sciences, Erciyes University, 38280 Kayseri, Turkey

Fulya Öner Armağan [2], Fen Bilgisi Eğitimi ABD, Faculty of Education, Erciyes University, 38280 Kayseri, Turkey

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Abstract

Socio-scientific issues take their content from situations that can be encountered in daily life. Therefore, teaching these subjects is among the important aims of science education. This study aims to determine the views of science teachers on socio-scientific issues. The study was carried out with 26 science teachers (18 women and 8 men) working in schools affiliated with the Ministry of National Education in the city centre of Kayseri in the 2020–2021 academic year. Open-ended document questions were used as a data collection tool in the study. Content analysis was used in the analysis of the qualitative data obtained in the study. It was concluded that some science teachers did not take any courses related to socio-scientific issues and their teaching in education faculties during their undergraduate education, while the content of existing courses only provided information on some socio-scientific issues.

Keywords: Science education, science teachers, socio-scientific issues;

[*] ADDRESS FOR CORRESPONDENCE: Institute of Educational Sciences, Erciyes University, 38280 Kayseri, Turkey.
E-mail address: hanife.fani@outlook.com

1. Introduction

Today, to keep up with science and technology, the education system is being restructured in many countries. Since 2004, the education programmes in our country have been changed or rearranged in certain periods according to the needs. As a result, it is aimed to raise each individual as an individual with science and scientific literacy, with the increase in students doing/applying science, understanding science correctly and increasing their interest and skills in science (Yolagiden, 2017). The science curriculum expects students to be individuals who research, question, think and comment on the situations they encounter. Therefore, it aims to make them individuals who learn and develop attitudes, skills, understanding and scientific knowledge towards science (MEB, 2013).

It is emphasised that issues such as cloning, GMO (genetically modified organism) foods, organ transplants, nuclear power plants and global warming, which are open to discussion and closely related to society, should be addressed more in the curriculum (Demiral & Çepni, 2018; Kılınç et al., 2013; Tsai, 2002). Sadler and Zeidler (2004) defined being able to discuss and analyse socio-scientific issues as one of the complementary components of scientific literacy. For a subject to be defined as a socio-scientific subject, it must have at least two criteria: (a) the content of the subject is related to science and (b) it is socially important and has meaning (Ayvacı, Bülbül, & Türker, 2019; Eastwood et al., 2012). Socio-scientific issues represent social problems and dilemmas that hold both social and scientific issues together (Patronis, Potari, & Spiliotopoulou, 1999; Sadler & Zeidler, 2004; Topçu, Muğaloğlu, & Güven, 2014; Zeidler, Walker, Ackett, & Simmons, 2002). Although these types of issues include ethical and moral elements, they become a difficult and very complex subject in terms of scientific knowledge and methodological/technological ties and are still being discussed by societies today (Sadler, 2004; Türkmen, Pekmez, & Sağlam, 2017). With this aspect, socio-scientific issues occupy the agenda of Turkey, as in every country. For example, socio-scientific issues such as 'Akkuyu, Sinop Nuclear Power Plant Projects, Green Road Project in the Black Sea', which are frequently on the agenda, are subjects that are turned into action by individuals with different views (Yapıcıoğlu & Kaptan, 2017).

Kolstø et al. (2006) emphasise that it is difficult to decide on socio-scientific issues and that political–ethical and scientific inquiry should be made while making a decision. Socio-scientific issues are controversial issues that are handled from different perspectives and cannot be easily decided on. Socio-scientific issues are complex and contain uncertainties as they contain open-ended questions. Socio-scientific issues take their content from situations that can be encountered in daily life. Therefore, teaching these subjects is among the important aims of science education (Albe, 2008; Nielsen, 2012). Social concerns, dilemmas and ethical rules in socio-scientific issues should not be considered separately from science. Conscious individuals become aware of medical, ethical, legal and psychological factors when making decisions on these issues, and this affects their decision-making process (Demiral & Türkmenoğlu, 2018). Osborne, Erduran, and Simon (2004) stated in their studies that socio-scientific issues provide useful content as they push students to discuss and enable them to evaluate their thoughts in this process.

1.1. Purpose of the study

Studies in the literature clearly show that there is a need to include socio-scientific issues in science lessons. Teachers have a great role in teaching these subjects. It is important to train teachers to follow the vision of the science curriculum. In this case, this study aims to determine the views of science teachers on socio-scientific issues. The research problem is 'What are the views of science teachers on socio-scientific issues?'

2. Materials and methods

In this study, a qualitative research approach was preferred. Qualitative research enables us to understand some unknown situations holistically by using the information collected in the natural environment through methods such as interviews, observation and document analysis (Yıldırım & Şimşek, 2008).

2.1. Participants

The sample of the study consists of 26 science teachers working in Kayseri province and its central districts. The open-ended document questions developed by the researchers were applied to the teachers in the study group. Among the teachers to whom open-ended document questions were applied, women were coded as K1, F2, K3… and men were coded as E1, E2, E3…. The information about

gender, educational status, seniority and age of the teachers who applied the open-ended document question form is given in Table 1.

Table 1. Demographic characteristics of science teachers participating in the research

Demographic features		***f***	**%**
Gender	Female	18	69.2
	Male	8	30.8
Professional seniority	1–5	9	34.6
	6–10	11	42.3
	11–15	4	15.3
	16–20	2	7.6
Graduated department	Science teacher	26	100.0
Graduated university	Erciyes U.	9	34.6
	Hacettepe U.	2	7.6
	KSU.	1	3.8
	Çukurova U.	1	3.8
	Ahi Evran U.	3	11.5
	Atatürk U.	1	3.8
	Gazi U.	3	11.5
	Cumhuriyet U.	4	15.3
	Sütçü imam U.	1	3.8
	Yüzüncü Yıl U.	1	3.8
	Licence	13	50.0
Education status	Degree	12	46.1
	Doctorate	1	3.9

(U = University)

2.2. Data collection tools

In the study, document analysis, one of the qualitative research methods, was preferred. According to Çepni (2007), document analysis is 'the process of collecting existing records and documents related to the work to be done and coding them according to a certain norm or system'. A document consisting of 12 open-ended questions was developed by the researchers to determine the

views of science teachers on socio-scientific issues, how they conduct the teaching process on socio-scientific issues, which teaching and methods they use and their suggestions for effective teaching of socio-scientific issues. The validity and reliability studies of the developed open-ended document questions were conducted by consulting three field experts. To increase the content validity of the open-ended document questions, some of the questions were revised and reduced to 12 questions from 15 questions, taking into account the feedback received from the experts.

2.3. Data analysis

Data analysis of the research was carried out using content analysis. The purpose of content analysis is to reach concepts that can explain the data. The collected data are organised and conceptualised for this purpose, and themes that will explain the contents are determined (Yıldırım & Şimşek, 2008). In this study, content analysis, which is one of the qualitative data analysis, was used to reveal the unclear scopes and opinions by asking how questions and conducting detailed research. In this context, codes were created from the data obtained from participant open-ended document questions. Participants' answers are presented in tables with codes. To ensure internal validity, direct quotations are included and necessary explanations are given below the tables.

3. Results

3.1. Findings obtained from open-ended document questions

In the open-ended document questions applied to science teachers, they were asked, 'What do socio-scientific issues mean to you? Please explain'. The answers given to the question 'Explain' is shown in the form of themes and codes in Table 2.

Table 2. Science teachers' 'What do socio-scientific issues mean to you?' themes and codes obtained from the answers given to the question 'Explain'

Theme code		Teacher codes
Issues	Scientific subjects	K1, K4, E5, E7, K11, K20, K22, K23, K24
	Social topics	K1, E8, E9, E10, E12, K13, E16, K17, K22, K23, K24, K25
	Social issues	K4, E7, E15, K18, K25
	Controversial issues	K2, E6, E8, K11, E15, E16, K17
Issues related to daily life	Socio-scientific	K3, K14, K19, K20, K26
	Environmental issues	K10, E12
	Open-ended critical issues	K2, K11

When Table 2 is examined, it is seen that the answers of science teachers about socio-scientific issues are defined as scientific, social, controversial, environmental and open-ended issues related to daily life. On these subjects, the teacher coded K2 stated that they are open-ended, criticisable, open to discussion and do not have a definite correct answer. Similarly, the teacher coded K11 replied, 'Scientific issues that are complex, open-ended, uncertain, open to discussion, and that concern the society as well'.

The answers given by the science teachers to the question 'Have you received any training on socio-scientific issues?' are in Table 3 in the form of themes and codes.

Table 3. Themes and codes consisting of the answers given by the science teachers to the question 'Have you received any training on socio-scientific issues?'

Theme code		Teacher codes
Yes	I contributed and increased my level of knowledge	K4, K5, E9, K11, E15, K19, K20, K22, K24, K25
No	Not educated	K1, K2, K3, E6, E7, E8, K10, E12, K13, K14, E16, K17, K18, K21, K23, K26

When Table 3 is examined, it is seen that the answers of science teachers about whether they have received education on socio-scientific issues are grouped under two themes. Teachers stated that

they received training and contributed by increasing their level of knowledge. In this regard, the teacher with the code E15 said, 'I received training during my undergraduate education. I think that it increased my level of knowledge'. Similarly, the teacher with the code K19 stated, 'I think that my level of knowledge on these subjects increased during the courses during my master's and doctoral periods'.

In the open-ended document questions applied to science teachers, the answers given to the question 'Do you think you have enough knowledge about teaching socio-scientific issues?' are in Table 4 as themes and codes.

Table 4. Themes and codes consist of answers given by science teachers to the question 'Do you think you have sufficient knowledge about teaching socio-scientific issues?'

Theme code		**Teacher codes**
Yes	Article/thesis	E5, E6, E8, E9, E12, E15, E16
	Internet/media/animation	E9, K19, K20, K25
	Scientific journals	K21, K25
	Master's/doctorate education	E6, E15, K19, K20, K24
	Tubitak project	E12
	Current events	E16, K19, K20, K21, K24
No	Books/magazines	K1, K3, K4, E7, K10, K14, K17
	Internet/YouTube	K1, K2, K4, K3, K14, K17, K18, K23, K26
	Article/thesis	K4, K10, K11, K13, K18, K22, K26

When Table 4 is examined, the answers of science teachers that they have sufficient knowledge about the teaching of socio-scientific issues are grouped under two themes. Some science teachers stated that they gained their knowledge about the teaching of socio-scientific issues from scientific journals, TÜBİTAK project, article/dissertations, graduate and doctorate education, current events and information sources such as media and animation on the Internet. In this area, the teacher with the code E12 replied, 'Yes, I get this information from various scientific articles, textbooks, TUBITAK scientific journals, and research I have done on the Internet'.

In the open-ended document questions applied to science teachers, the answers given to the question 'Are there any units/units in the science programme that you think are related to socio-scientific issues? If so, what are they? Please explain'. are given in Table 5 as themes and codes.

Table 5. Science teachers' 'Are there any units/units in the science programme that you think are related to socio-scientific issues? If so, what are they?' themes and codes consist of answers to the question 'Explain'

Theme code		**Teacher codes**
Units/subjects	Stem cells	K1, E7, K23
	GMO	K1, K2, E5, E6, E7, E8, K10 ,K11, K14, E15, K22
	Cloning	K1, K2, K3, E9, K11, E15, E16, E18, K22, K23, K24
	Genetic code-DNA	K2, K4, E12, E16, K20, K23
	Biotechnology/Gene Eng.	K4, E5, E12, K13, E16, K20, K25, K26
	Global warming	E6, E7, E9, K13, K14, K17, K19, K20, K22, K24
	Nuclear energy	K3, E6, E7, E8, E9, K10, K11, K13, K14, E15, K19, K20
	Organ donation	E5, K10, K11
	Vaccine	K22
	Recycling/sustainable development	K22, K25, K26

The answers of the science teachers about which subjects in the science programme are related to socio-scientific subjects are given in Table 5. It has been observed that science teachers answered these subjects such as stem cells, GMO, global warming, cloning, biotechnology/genetic engineering, sustainable development, vaccine and genetic code/DNA. In this regard, the teacher with the code E5 stated 'GMO products, artificial selection, cloning, genetic engineering studies, and species breeding concepts can be given as examples of socio-scientific issues in biotechnology in the class DNA and genetic code unit. In addition, non-renewable energy resources in the subject of 6th class matter and fuels in the heating unit are examples of socio-scientific issues'.

In the open-ended document questions applied to science teachers, they were asked 'Do you think that teaching socio-scientific issues in science class is beneficial?' The answers to the question 'Why?' are shown in Table 6 as themes and codes.

Table 6. Science teachers' 'Do you think teaching socio-scientific issues in science class is beneficial?' themes and codes consist of answers to the question 'Why?'

Theme code		**Teacher codes**
Benefits to the teacher	Source of information	K1, K2, E6, E7, K10, K17
	Awareness	K3, K13, K14, K24
	Professional competence	K4, E15, K20, K21, K26
	Multidimensional thinking	E5, E8, E9, E12, E16, K18, K19, K22, K23, K25
	Science literate	K11
Benefits for the student	Critical thinking	K1, K2, K3, E5, E7, E8, K10, K13, K18, K24
	Different perspective	K4, E6, E9, E12, E15, E16, K19, K20, K22, K23, K25
	Science literate	K11, K17, K21

When Table 6 is examined, it is seen that the views of science teachers about the usefulness of teaching socio-scientific subjects are grouped under two themes. Science teachers answered the benefits of the teacher as an information source, awareness, professional competence, multidimensional thinking and science literacy. In this regard, the teacher with the code E5 said, 'Some of the general objectives of the science course; To raise individuals who produce solutions to social problems, have developed environmental awareness, protect nature and think scientifically. Teaching socio-scientific issues, students' ability to freely express their thoughts on these topics, and having discussions based on scientific data on the subject will be very effective in achieving the general goals of science education'. The teacher with the code E9 said, 'It is useful for us. The more we, as teachers, integrate today's current problems into the curriculum, the more we can connect with life and create the big picture more easily, as if it were pieces of a puzzle. Our scientific literacy level develops further, enabling us to look at it from different angles'.

In the open-ended document questions applied to science teachers, they were asked 'How do you explain socio-scientific issues in your lessons? Please explain'. The answers given to the question are given in Table 7 in the form of themes and codes.

Table 7. Science teachers' 'How do you explain socio-scientific issues in your lessons?' themes and codes consist of answers to the question 'Explain'

Theme code		**Teacher codes**
Lecturing examples	From daily life	K1, K2, K3, K4, K10, K14, E15, K21
	News/video/animation	K4, E5, E6, E9, E12, E16, K17, K20, K25, K26
	Discussion/debate	E9, K11, E15, K18, K23, K24, K25
	Question answer	K10, K11 ,K13, K18
	Visual presentation/documentary	K19, K20, E16, K17
	Photo/caricature/worksheet	E6, E7, K19

	Travel	K23, K25, K26
	Constructivist approach	K22, K24

In Table 7, it is shown that science teachers explain socio-scientific issues in their classes with examples from daily life, through trips, visual presentations, question/answer, video/animation, discussion/debate, worksheets and adopting the constructivist approach. In this regard, the teacher with the code E7 said, 'I give the students a text, a cartoon, or a worksheet and ask some questions in this document and I want the students to say what comes first through brainstorming. By answering the questions there, I try to bring different perspectives of the students to the fore. In the face of these answers, I try not to use a true or false statement in any way. In addition, I direct students to research this subject, and by providing an environment for students to present their knowledge, students present their knowledge to their friends. Of course, at this point, we are catching up with a discussion environment in the form of questions and answers'.

In the open-ended document questions applied to science teachers, they were asked 'Which teaching methods do you use to teach socio-scientific subjects in your lessons? The answers to the question 'Why?' are given in Table 8 in the form of themes and codes.

Table 8. Science teachers' 'Which teaching methods do you use to teach socio-scientific subjects in your lessons?' themes and codes consist of the answers to the question 'Why?'

Theme code		**Teacher codes**
Methods and techniques	Brainstorming	K1, K2, K4, E9, K10, K14, K20, K22, K24
	Case study	K1, E15, E16, K23
	Presentation method	K3, E5, E12, K25
	5E model	E6, K18
	Argumentation	E7, K10, K13, K19, K22
	Six hat method	E9, K10, K14
	Discussion method	E8, K11, E15, K18, K19, K23, K24
	Project and problem-solving method	K11, E16, K17, K21, K23, K26
	Simulation	K24
	Travel-observation/internet-based	K26
	Debate/opposite panel/concept cartoon	K4, K14, K19,

When Table 8 is examined, the teachers stated that they use case study, brainstorming, 5E model, presentation method, argumentation, six hats method, discussion method, project, problem-solving method, trip-observation, debate, contrast panel and concept cartoon techniques in teaching socio-scientific issues. The teacher with code K1 participating in the study said, 'I use discussion, brainstorming and case studies methods. I use these methods in terms of putting forward more ideas and empathising'. In addition, the teacher with the code E6 said, 'I mostly use the 5E learning model in my lessons. During the deepening phase of the course, we organise activities to enable them to comment on these issues. For example, I think that socio-scientific issues are very suitable for the focus of our discussions during the deepening phase of the course. Students deal with the subject from different angles and have an idea about the subject'.

In the open-ended document questions applied to science teachers, they are asked 'Are there any problems that may arise during the teaching of socio-scientific issues in the classroom environment? Please explain'. The answers given to the question are given in Table 9 in the form of themes and codes.

Table 9. Science teachers' 'Are there any problems that may arise during the teaching of socio-scientific issues in the classroom environment?' themes and codes consist of answers to the question 'Explain'

Theme code		Teacher codes
Yes	Causes conflict.	K1, K2, K4, E6, E7, E9, E15, K17
	Different opinions arise.	E5, E8, K10, K11, E12, K14, E16
	Not understanding the subjects	K20, K23, K24
	Subject structure-belief status	K19, K22, K25
	Misconception	K18, K19
	Lack of material	K18, K19
None	Reason not specified	K3, K13, K21, K26

When Table 9 is examined, it is seen that the views of science teachers regarding the problems that may arise during the teaching of socio-scientific issues in the classroom are grouped under two themes. It has been observed that some science teachers have stated that the problems that may arise are caused by conflict, different opinions arise, the subject is not understood, the state of belief, misconceptions and lack of material. In this regard, the teacher coded E7 said, 'Students may have some difficulty in showing their reasoning skills in teaching socio-scientific issues. Some socio-scientific issues do not attract students' attention. Some students state that the course is empty in the teaching of socio-scientific issues. Students with low self-confidence are hesitant to express their thoughts. In the discussion environment, students sometimes do not respect each other's ideas'.

In the open-ended document questions applied to science teachers, they were asked 'Should the teacher reflect his views to the class in discussions on socio-scientific issues? Why is that?' The answers given to the question are given in Table 10 in the form of themes and codes.

Table 10. Science teachers' 'Should the teacher reflect his/her views to the class in discussions on socio-scientific issues? Why is that?' themes and codes consisting of answers to the question 'Why'

Theme code		Teacher codes
Should be	Non-reflective lens	K1, E6, K12, K20, K24
	Must be impartial	K2, K3, K4, E5, E8, E9, K11, K13, K14, K19, K21, K22, K23
Reflective	Must be a role model	K18, K25, K26
	At the end of the topic	E16, K17
	Transmit without adding precision	E7, K10, E15

The reflection of the science teachers' own views in the discussions on socio-scientific issues is given in Table 10 under two themes. Some teachers said that they should not reflect their views in the discussions and answered that they should be objective and impartial. On this subject, the teacher with the code K1 said, 'First of all, he should not reflect, but after the students have discussed this issue thoroughly, that is, at the end of the lesson, the teacher should also explain his thought. It is important in terms of being an example to the student'. Similarly, in the K2 arm, the teacher said, 'No, the teacher should be neutral. For the students to express their opinions freely, the teacher should not express their own opinion'.

In the open-ended document questions applied to science teachers, they were asked 'What would be your advice to other science teachers in teaching socio-scientific issues in science? Please explain'. The answers given to the question are given in Table 11 in the form of themes and codes.

Table 11. Science teachers' 'What would be your advice to other science teachers in teaching socio-scientific issues in science?' themes and codes from their answers to the question 'Explain'

Theme code	Teacher codes

Recommendations	Up-to-date information should follow	E6, E8, K11, K21
	Should use different method technique	K4, E5, E9, K10, K23, K24, K26
	Include the student in the process	E15, K18, K19, K22, K25
	Should do more research	E7, E12, K11, K13, K14, E15, K17, K20, K21
	Sharing thoughts	K1, K2, K3

When Table 11 is examined, it is seen that science teachers stated that they should follow current information, use different methods and techniques, involve the student in the process, do more research and share their thoughts in the teaching of socio-scientific issues. In this regard, the teacher coded E6 said, 'I think that socio-scientific issues are not given enough attention in the curriculum. In this respect, I think that teachers should follow up-to-date information on socio-scientific issues and draw more attention to socio-scientific issues'. Similarly, teacher E9 said, 'We can at least create groups with students and raise awareness of such situations by focusing on such issues in the group teachers' board (both in the school and in the district). It is clear that to solve such problems, it is necessary to start from somewhere, and it will contribute to the education of children at this age level to become a much more conscious, questioning and researching generation. I highly recommend trying different teaching method techniques (six hats, snowballs, station, fishbone, etc.)'.

In the open-ended document questions applied to science teachers, they were asked 'Is there a relationship between daily life and socio-scientific issues? Why is that? Please explain if any'. The answers given to the question are given in Table 12 in the form of themes and codes.

Table 12. Science teachers' 'Is there a relationship between daily life and socio-scientific issues? Why is that? themes and codes consist of the answers given to the question 'Explain if any'

Theme code		**Teacher codes**
Food in relation to	Daily life	K4, E6, E8, K10, E12, K13, K14, E15, E16, K18, K22, K23, K26
	Health	K1, K2, K4, E6, E8, E9, E12, K13, K14, E15, K17, K19, K22, K25
	Environment	K2, E6, E9, E12, K13, K14, E15, K23, K24, K25, K26
	Power Plants	E16, K17, K23, K24
	Be up to date	K3, E5, E7, K11, K20, K21

When Table 12 is examined, science teachers expressed the relationship between socio-scientific issues and daily life as food, health, environment, power plants and being up-to-date. The teacher with the code K4 participating in the research said, 'There is. Because socio-scientific issues contain issues that are intertwined with daily life. For example, GMOs used in the food industry, cloning or stem cell studies that are mixed in the medical industry are socio-scientific issues that we encounter in daily life'. Similarly, teacher E6 said, 'There is a strong relationship between daily life and socio-scientific issues. Because these issues directly affect both ourselves and other people. I think the power of socio-scientific issues stems from this. For example, GMOs are closely related to us or society and are found in the structure of some of the foods we consume in our daily lives. This is extremely important for our health. On the other hand, various activities that may cause environmental pollution can directly affect both ourselves and society. For example, while electricity is produced in thermal power plants, the environment is polluted on the other hand'.

In the open-ended document questions applied to science teachers, they were asked 'What can be done to increase teachers' proficiency in socio-scientific issues throughout their professional life? Please explain'. The answers given to the question are given in Table 13 in the form of themes and codes.

Table 13. In the questions of science teachers, 'What can be done to increase teachers' proficiency in socio-scientific issues throughout their professional life?' themes and codes consist of answers to the question 'Explain'

Theme code		Teacher codes
Proficiency	Seminar/conference	K1, K2, E6, E9, K11, K14, K17, K19, K22
	Scientific journals	K3, E9 ,K20, K21, K25
	In-house training	E5, E6, E7, E9, K10, E12, K13, E15, E16, K24, K26
	TUBITAK	E9, E12, K23
	Congress	K4, E6, K19, K22
	Article/thesis	K11, K18, K25

When Table 13 is examined, it is stated that science teachers benefit from in-service training, seminars/conferences, scientific journals, TUBITAK, congresses, articles and theses to increase their proficiency in socio-scientific issues throughout their professional life. In this regard, the teacher with the code E5 stated, 'It should be taken into in-service training, if necessary, the teachers should discuss these issues among themselves in these training'. Similarly, the teacher with the code E6 said, 'You can follow articles or news about socio-scientific issues. Apart from this, they can attend in-service training on socio-scientific issues. Similarly, they can attend training or symposiums organised by universities. They can participate in projects involving teachers on socio-scientific issues'.

4. Discussion

When the views of science teachers on socio-scientific issues are examined, the following discussions and conclusions were reached as a result of the findings obtained from the study. When the answers given by science teachers to open-ended document questions are examined, it is seen that they define the concept of a socio-scientific issue as social, scientific and controversial issues the most, and the environmental and open-ended issues the least. Generally, it is seen that socio-scientific issues are not associated with science and technology, but are stated as scientific, controversial and social issues. It can be explained by the fact that the science teachers participating in the research do not associate the content and definition of the concept of a socio-scientific issue with science and they have a low level of knowledge about the content (Akbulut & Demir, 2020).

It was observed that some of the science teachers participating in the research did not receive any training on socio-scientific issues and how to teach them during their undergraduate education but were only informed about some socio-scientific issues that exist in the content of different courses. It was concluded that some science teachers received training on socio-scientific issues and their teaching during their undergraduate or graduate education, and this education contributed a lot to themselves and increased their knowledge level (Nida, Rahayu, & Eilks, 2020). It has been concluded that most of the science teachers participating in the research have the field knowledge to discuss these topics, which they generally consider themselves competent, regarding the methods and techniques they use in teaching and explaining socio-scientific issues, and they have constructivist approaches to teach these topics.

It has been determined that some science teachers participating in the study have information about socio-scientific issues through the Internet, books and media, while the remaining science teachers follow articles, theses and scientific journals for information about these subjects. From this, it was concluded that some science teachers do not question whether there is scientific and correct information because they obtain the information they have acquired about socio-scientific issues through the media and the Internet. It has been concluded that science teachers are aware of the fact that they can increase their proficiency against socio-scientific issues by participating in training such as seminars, conferences, symposiums, Tübitak projects and in-service to increase their proficiency throughout their professional life (Irmak, 2018). They adopt constructivist approaches in student-centred learning environments used in teaching socio-scientific issues. Collaborative learning methods such as brainstorming, case studies, argumentation, problem-solving, project development, debating, and six hats were sufficiently mentioned by science teachers. Based on this, it was concluded that science teachers' preference for these methods and techniques in the teaching of socio-scientific subjects enables students to learn better, creates permanent learning for students, lecturers' time is spent more efficiently and saves time.

It was concluded that the teachers should not reflect their ideas in order not to influence the students in the teaching of socio-scientific issues (Sadler, Foulk, & Friedrichsen, 2017), and should be objective and impartial and that the student's opinion may change according to the content of the socio-scientific issue discussed in the classroom, according to their thought, moral and religious structure. At the end of the discussion, it was concluded that some science teachers should reflect their opinions to the class without adding certainty to be a role model for the student. In this study, it was concluded that the teachers were sufficient in the answers given by the science teachers to the open-ended document questions, advising other science teachers in the teaching of socio-scientific issues such as following up-to-date information, using different methods and techniques, involving the student in the process, sharing their thoughts and doing more research.

5. Conclusion

As a result of the study, the science teachers participating in the research could not directly associate socio-scientific issues with science, their awareness of the definition and content of the concept of the socio-scientific issue was partially sufficient, the socio-scientific issues they were most interested in were on the agenda throughout the country and generally focused on the discussed topics and the information on these subjects was mostly Internet and media.

It was concluded that some science teachers received training on socio-scientific issues and teaching during their undergraduate or graduate education, and this education contributed a lot to themselves and increased their knowledge level. It has been concluded that socio-scientific issues are not sufficiently included in the science textbooks and curriculum, and no content will inform the teacher about how to teach the included socio-scientific issues. Some suggestions were made regarding the findings obtained as a result of the study.

6. Recommendations

1. It is thought that science teachers' spending more time on socio-scientific issues in their classes will help students learn these subjects more permanently and effectively, and can increase their knowledge and awareness levels by contributing to the development of decision-making skills.

2. By preparing a guide material about socio-scientific issues different from the subjects in the science curriculum and how to teach these subjects, it can be ensured that science teachers have information about the contents of these subjects.

3. The guide materials to be prepared by participating in in-service training, panels, congresses, seminars and discussion environments of science teachers, their lack of knowledge, deficiencies in classroom conditions and socio-scientific issues arising from their own beliefs, experiences and motivations and their teaching can be increased with education and training programmes by using methods and techniques.

4. Teachers and students are also affected by ethical and moral dimensions of decisions on socio-scientific issues. For this reason, ethical and moral dimensions of socio-scientific issues can also be included in the science curriculum.

5. Increasing the study of socio-scientific issues with students can be applied at primary, secondary and high school levels.

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