p-ISSN 2355-5343
e-ISSN 2502-4795
http://ejournal.upi.edu/index.php/mimbar

Article Received: 12/04/2022; Accepted: 20/08/2022
Mimbar Sekolah Dasar, Vol. 9(2), 303-316
DOI: 10.53400/mimbar-sd.v9i2.45357

Affective Tendencies of Science Teachers in Teaching Socioscientific Issues

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Abstract. This study aims at identifying the intrinsic affective tendencies of science teachers in teaching socioscientific issues (SSI) based on different variables and their personal perspectives. The participants of the study consisted of 394 science teachers who taught at public schools during the 2021 and 2022 academic years. Regarding the research method, a mixed method that combined quantitative and qualitative research methods was employed in this study. Quantitatively, the "Affective Tendency Scale for Teaching Socioscientific Issues" comprising four dimensions and 28 items was applied to 394 science teachers. Meanwhile, qualitatively, semi-structured interviews were conducted with six science teachers from the total participant teachers who volunteered to take part. Subsequently, for statistical operations in this study, the SPSS program was utilized to analyze the quantitative and qualitative data in a descriptive manner. Conclusively, the results revealed that science teachers' affective tendencies in teaching SSI (Socioscientific Issues) were high on both quantitative and qualitative levels.

Keywords: affective tendency, science teacher, science teaching, socioscientific issues, mixed method

1. Introduction

Science and society confront us as two fundamental realities that impact each other and cannot be dissociated. A scientific subject must have a social dimension as well, and along with that social dimension, the subject has begun to affect the society as a whole and has emerged as a socioscientific issue (SSI). In many previous studies, tentative definitions were offered for SSI, which stated that there were controversial issues that were difficult to decide on, considered from different perspectives in almost every society, contained a dilemma without a single correct answer, and required reasoning (Owens et al., 2021; Sadler, 2004; Sadler & Zeidler, 2009). In addition to including moral and ethical components, such issues become a very complex and challenging subject in terms of scientific knowledge and methodological/technological ties, which are still discussed by societies in the present (Türkmen et al., 2017).

1.1 Problem Statement

Teachers play a significant role in transferring SSI from the curriculum to the classroom, simply because they must have sufficient and relevant subject competence and mentality about SSI teaching. When students with insufficient knowledge about SSI are taught scientific information about the subject using the appropriate methods and techniques, they can interpret it using their relevant knowledge and information and express their thoughts. It is important that teachers should be able to discover the knowledge shortcomings in students about these issues that we frequently encounter in daily life, and that these shortcomings should be eliminated by using the appropriate methods and techniques (Yıldırım & Bakırcı, 2020). While teaching the subjects in science lessons, teachers should pay attention to preparing an environment in the classroom for the solution of problems encountered in daily life and benefit from scientific information while resolving problems (Türkmen et al., 2017). Therefore, one of the most important variables in the teacher's effective teaching of a subject in the classroom is the pedagogical field competence. For this reason, teachers should closely follow the constantly

changing and developing technology, and be able to transfer knowledge and information to their students accurately and responsibly by receiving the necessary training (Topçu et al., 2014). Nevertheless, teachers' attitudes and approaches towards SSI will positively affect and help the students become the individuals who have acquired scientific process skills, are scientifically literate, and are able to do reasoning (Gürbüzkol & Bakırcı, 2020). If the teachers who teach SSI in science classes help their students learn problem-solving skills, the students will be able to resolve a problem they encounter in daily life based on these skills acquired in the future. Besides, students' ability to make decisions through discussions will improve, and the anxiety of the teacher will diminish or disappear (Varal & Belge Can, 2020).

1.2 Related Research

It has been observed that teachers are not competent enough to teach SSI in the classroom in terms of methods, techniques, and content knowledge (Saunders & Rennie, 2013). Science teachers have difficulties in teaching these subjects due to the controversial nature of socioscientific issues (Nielsen, 2012; Topçu, 2008). In addition, teachers have difficulties in classroom management during such controversial issues because they often skip these issues (Day & Bryce, 2011; Lee et al., 2006). It is thought that increasing the number of studies to be carried out in this field is significant in terms of contributing to the identification of the current situation, improving the existing situation, and seeking solutions to the problems.

1.3 Research Objectives

This study aims at identifying the affective tendencies of science teachers when teaching socioscientific issues. The following research questions have been formulated in keeping with this principal objective.

1- What are the affective tendencies of science teachers in teaching socioscientific issues and what are their opinions about them?
2- Do the affective tendencies of science teachers regarding teaching socioscientific issues differ by the independent variables (gender, level of education, tenure, place of work)?

2 Theoretical Framework

In recent years, SSID has been considered to be an effective context for science literacy, which is one of the important objectives of science education (Johnson et al., 2020). SSI is commonly acknowledged to be one of the most effective learning environments in achieving the scientific literacy objective (Holbrook & Rannikmae, 2007; Zeidler et al., 2019). Numerous educators have emphasized that socioscientific issues should be included in the science curriculum as an attempt to enhance the knowledge and information of individuals and improve the level of science literacy in society (Driver et al., 2000; Zeidler et al., 2002; Zeidler & Keefer, 2003; Zeidler & Sadler, 2008). In Turkey, socioscientific issues were initially included in the Ministry of National Education's Science Curriculum of Turkey in 2013 with the purpose of "Developing scientific thinking habits by using the socioscientific issues" (MoNE, 2013). The primary objectives of the Ministry of National Education Sciences Curriculum, which was renewed in 2018, took its final form and was implemented as "Developing reasoning ability, scientific thinking habits and decision-making skills by using the socioscientific issues" (MoNE, 2018). For this reason, as mentioned above, teachers play a significant role in transferring SSI from curriculum to the classroom due to their sufficient and relevant competence and mentality about SSI teaching.

3 Method

3.1 Research Design

This study aims at identifying the affective tendencies of science teachers towards teaching socioscientific issues by employing one of the mixed methods, that was an embedded experimental design. An embedded experimental design collects qualitative and quantitative data either sequentially or simultaneously, and a group of data is collected to support the other group of data. The purpose of using the quantitative and qualitative methods simultaneously

is that these methods complement each other. Furthermore, the study will have a high level of validity and reliability (Creswell & Clark, 2011). In the present study, the "Affective Tendency Scale for Teaching Socioscientific issues" developed by Sakmen & Genç (2021) was utilized as the quantitative data tool. Meanwhile, in order to support the quantitative dimension of the study, semi-structured interviews were conducted with the science teachers.

3.2 Participants

Quantitatively, the participants of the study were selected using random sampling method, resulting in 394 science teachers teaching at the public schools affiliated with the Ministry of National Education in Turkey during the 2021 and 2022 academic years. Semi-structured interviews were conducted with six science teachers who volunteered to participate as the participant teachers. The demographic characteristics of the participants are presented in Table 1.

Table 1. Demographic Characteristics

Variable		**Frequency**	**%**
Gender	Female	317	80.5
	Male	77	19.5
Educational background	Undergraduate Degree	299	75.9
	Master's Degree	79	20.1
	Doctorate Degree	16	4.0
Place of work	Metropolitan City	101	25.6
	City Center	60	15.2
	Sub province (town)	138	35.0
	Village	95	24.1
Tenure	1-5 years	183	46.4
	6-10 years	100	25.3
	11-15 years	63	16.0
	16 and above	48	12.2
	Total	394	100

3.3 Data Collection

The Affective Tendency Scale for Teaching Socioscientific Issues, developed by Sakmen & Genç (2021), was utilized as a data collection tool in this study. When the structure of the scale was examined, it consisted of a total of 28 items in 5-likert type and four factors: Utility and Importance, Self-Efficacy, Attitude, Pedagogical Field Competence. In this scale, four items contained negative statements meanwhile the other 24 items contained positive statements. While scoring the scale items, they were coded to mark the positive and negative statements.

Within the scope of the qualitative dimension of the study, the researchers employed a semi-structured interview form with seven open-ended questions to determine the affective tendencies of science teachers toward socioscientific issues. The interviews were recorded when as requested by the participant teachers. Each lasted approximately 25-30 minutes.

3.4 Data Analysis

The interpretation of the arithmetic mean was implemented in order to identify what the sub-dimensions of the scale and the scores obtained in all of them signify. Affective tendencies were evaluated as "I totally agree: 4.21- 5.00 (very high)", "I agree: 3.41- 4.20 (high)", "I am undecided: 2.61- 3.40 (moderate)", "Disagree: 1.81- 2.60 (low)", "Strongly Disagree: 1.00- 1.80 (very low)".

The SPSS program was used for statistical operations in the study. The current study tested whether the data was normally distributed to analyze the data and identify the statistical techniques used in solving the sub-problems. Skewness and Kurtosis values of the collected data were examined, and it was found that the data ranged from -.406 to .835, meaning that they were distributed normally. The fact that the Skewness and Kurtosis values turned out to be

between +1.5 and -1.5 indicated that the data were parametric (Tabachnick & Fidell, 2013). Since the data had normal distribution, parametric tests were implemented. T-test was used for pairwise comparisons, One-Way Analysis of Variance (ANOVA) for multiple comparisons, and Tukey Test to identify the source of the difference.

In the qualitative part of the study, the semi-structured interviews conducted in line with the sub-dimensions of the scale were analyzed descriptively. The interviews with the teachers were recorded and transcribed. Each teacher was given codes such as T1, T2, T3, and so on, and themes and sub-themes were generated.

3.5 Validity and Reliability

In Table 2, it is possible to say that the Cronbach Alpha values for the entire scale were reliable based on factors, and also there was a high level of reliability available based on items. The fact that the Cronbach Alpha reliability coefficient was found to be .80 indicated that there was a high level of reliability, and the Cronbach Alpha value between .60 and .70 demonstrated that the data obtained could also be reliable (Cronbach, 1951).

Table 2. Reliability Results of Scale Factors

Factors	Number of Items	Original Scale Cronbach Alpha	Cronbach Alpha in this study
Self-Efficacy	4	.760	.794
Attitude	4	.607	.645
Utility and Importance	4	.814	.832
Pedagogical Field Competence	16	.912	.910
Total	28	.909	.905

The researchers developed a semi-structured interview comprising seven open-ended questions in order to identify the affective tendencies of science teachers towards socioscientific issues within the scope of the qualitative dimension of the study. A Turkish language teacher and two field experts provided input when preparing the questions, and the form was finalized after making suggested corrections. The interview was conducted at the time requested by the participant teachers and recording was don under their permission. Furthermore, before analyzing the data, participant confirmation was sought in an attempt to ask the participants whether the study findings accurately reflected their thoughts.

4 Findings

This section discusses the findings in the form of mean values of the scale, quantitative and qualitative findings.

Table 3. Mean values of the sub-dimensions of the scale

	N	X	s
Self-Efficacy	394	3.5260	0.68410
Pedagogical Field Competence	394	4.0441	0.46764
Attitude	394	3.3775	0.70648
Utility and Importance	394	4.1244	0.57133
TOTAL	394	3.8800	0.41684

Based on the sub-dimensions of the scale and the arithmetic mean values of all participating science teachers regarding teaching socioscientific issues presented in Table 3, Utility and Importance; the affective tendencies regarding the sub-dimensions of Pedagogical Field Competence and Self-Efficacy were high; the affective tendencies regarding the attitude sub-dimension were at a moderate level. Nevertheless, it turned out that affective tendencies were high based on the mean value of all items in the scale.

Based on the findings on how the affective tendencies of science teachers in teaching socioscientific issues changed by the variables of gender, educational background, place of work, and tenure. It was first examined whether the affective tendencies of science teachers towards teaching socioscientific issues differed by gender. The t-test results of the analyzes are presented in Table 4.

Table 4. Findings Regarding the Gender Variable

Factor	Gender	N	$\bar{x}$	Ss	Sd	t	p
Self-efficacy	Female	317	3.49	0.65	394	-1.46	.104
	Male	77	3.63	0.78			
Attitude	Female	317	3.44	0.64	394	3.76	**.000***
	Male	77	3.11	0.86			
Utility and Importance	Female	317	4.13	0.55	394	0.87	.337
	Male	77	4.06	0.64			
Pedagogical Field Competence	Female	317	4.05	0.43	394	0.93	.275
	Male	77	4.06	0.57			
Total	Female	317	3.90	0.40	394	1.27	.161
	Male	77	3.82	0.47			

(*p<.05)

The affective tendencies of science teachers in relation to the dimension of self-efficacy towards teaching socioscientific issues did not differ significantly by gender (p>.05). In Table 4, there was no significant difference by gender in the dimensions of utility and importance, and pedagogical field competence (p>.05). However, in the attitude sub-dimension, when the scores of female teachers ($\bar{x}$=3.44) and male teachers ($\bar{x}$=3.11) were analyzed, there was a significant difference in favor of women (p<.05). ANOVA test was applied to establish whether the affective tendencies of the participants towards teaching socioscientific issues differed by the variable of educational background (undergraduate, master's, and doctorate degrees) and the results of the analysis are presented in Table 5.

Table 5. Findings Regarding the Variable of Educational Background

Factor	Variance	Sum of Squares	df	Mean Square	F	p
Self-efficacy	Between Groups	12.309	2	6.155	14.023	**.000***
	Within Groups	171.612	391	0.439		
	Total	18 3.921	393			
	Between Groups	1.998	2	0.999	2.012	.135
Attitude	Within Groups	194.156	391	0.497		
	Total	196.154	393			
Utility and Importance	Between Groups	1.195	2	0.598	1.839	.160
	Within Groups	127.086	391	0.325		
	Total	128.281	393			
Pedagogical Field Competence	Between Groups	1.522	2	0.761	3.525	**.030***
	Within Groups	84.423	391	0.216		
	Total	85.945	393			
	Between Groups	1.341	2	0.670	3.915	**.021***
Total	Within Groups	66.946	391	0.171		
	Total	68.287	393			

*p<.05

When the scores of the participants for the whole scale were examined, there was a significant difference regarding the variable of educational background (F=3.915; p<.05). In the Tukey analysis, this difference was between the teachers doing their doctorate degree and teachers with an undergraduate degree and it was in favor of the teachers who were doing their doctorate degree. When the scores obtained by the participants from the attitude sub-dimension were examined, there was no significant difference in the variable of educational

background (F=2.012; p>.05). Similarly, in the sub-dimension of utility and importance, there was no significant difference by the variable of educational background (F=1.839; p>.05).

However, in the self-efficacy sub-dimension, there was a significant difference in relation to the variable of educational background (F=14.023; p<.05). The result of the Turkey analysis concluded that the significant difference in the self-efficacy sub-dimension among the teachers with an undergraduate degree, a master's degree and a doctorate was in favor of the teachers doing their doctorate degree. In addition, the significant difference between the teachers with master's and undergraduate degrees was in favor of teachers with master's degree. In the pedagogical field competence sub-dimension, there was a significant difference regarding the learning variable (F=3.525; p<.05). Tukey's results revealed that the significant difference was in favor of the teachers who were doing a doctorate degree and those with an undergraduate degree.

Table 6 illustrates the results of the ANOVA test to investigate whether the affective tendencies of the participants towards teaching socioscientific issues differed regarding the variable of the place of work (metropolitan city, city center, sub province (town), village).

Table 6. Findings Related to the Place of work Variable

Factor	Variance	Sum of Squares	df	Mean of Squares	F	p
Self-efficacy	Between Groups	1.055	3	0.352	0.750	.523
	Within Groups	182,866	390			
	Total	183.921	393			
Attitude	Between Groups	2.611	3	0.870	1.754	.156
	Within Groups	193.543	390			
	Total	196.154	393			
Utility and Importance	Between Groups	1.485	3	0.495	1.523	.208
	Within Groups	126.796	390	0.325		
	Total	128.281	393			
Pedagogical Field Competence	Between Groups	0.139	3	0.046	0.210	.889
	Within Groups	85.806	390	0.220		
	Total	85.945	393			
Total	Between Groups	0.292	3	0.097	0.559	.649
	Within Groups	67.994	390	0.174		
	Total	68.287	393			

*p<.05

When the data in the sub-dimensions of self-efficacy, attitude, utility and importance, pedagogical field competence regarding the participants' place of work (metropolitan city, city center, sub province (town), village) variable were examined, there was no significant difference in terms of the workplace variable (p>.05).

Table 7 shows the findings of the ANOVA test implemented to examine whether the affective tendencies of the participants towards the teaching of socioscientific issues differed regarding the variable of tenure of the participants (1-5 years, 6-10 years, 11-15 years, 16 and above).

Table 7. Findings Related to the Tenure Variable

Factor	Variance	Sum of Squares	df	Mean of Squares	F	p
Self-efficacy	Between groups	2.585	3	0.862	1.853	.235
	Within Groups	181.336	390	0.465		
	Total	183.921	393			
Attitude	Between Groups	1.851	3	0.617	1.239	.295
	Within Groups	194.302	390	0.498		
	Total	196.154	393			
Utility and Importance	Between Groups	0.768	3	0.256	0.783	.504
	Within Groups	127.513	390	0.327		

	Total	128.281	393			
Pedagogical Field Competence	Between Groups	1.314	3	0.438	2.018	.111
	Within Groups	84.631	390	0.217		
	Total	85.945	393			
Total	Between Groups	0.740	3	0.247	1.425	.235
	Within Groups	67.547	390	0.173		
	Total	68.287	393			

*p<.05

When the data of the participants in the sub-dimensions of self-efficacy, attitude, utility and importance, pedagogical field competence regarding the variable of tenure (1-5 years, 6-10 years, 11-15 years, 16 and above) were examined, there was no significant difference by the tenure variable (p>.05).

Semi-structured interviews with science teachers were conducted by recognizing the sub-factors of the scale used to support the quantitative data as the main theme. Nevertheless, it was attempted to establish how the science teachers identified the socioscientific issues. In this context, as a result of the qualitative data analysis, qualitative findings were investigated under five main themes: "Socioscientific Issues According to the Science Teachers, Self-Efficacy, Attitude, Utility and Importance, Pedagogical Field." The themes and sub-themes obtained as a result of the analysis are presented in Figure 1.

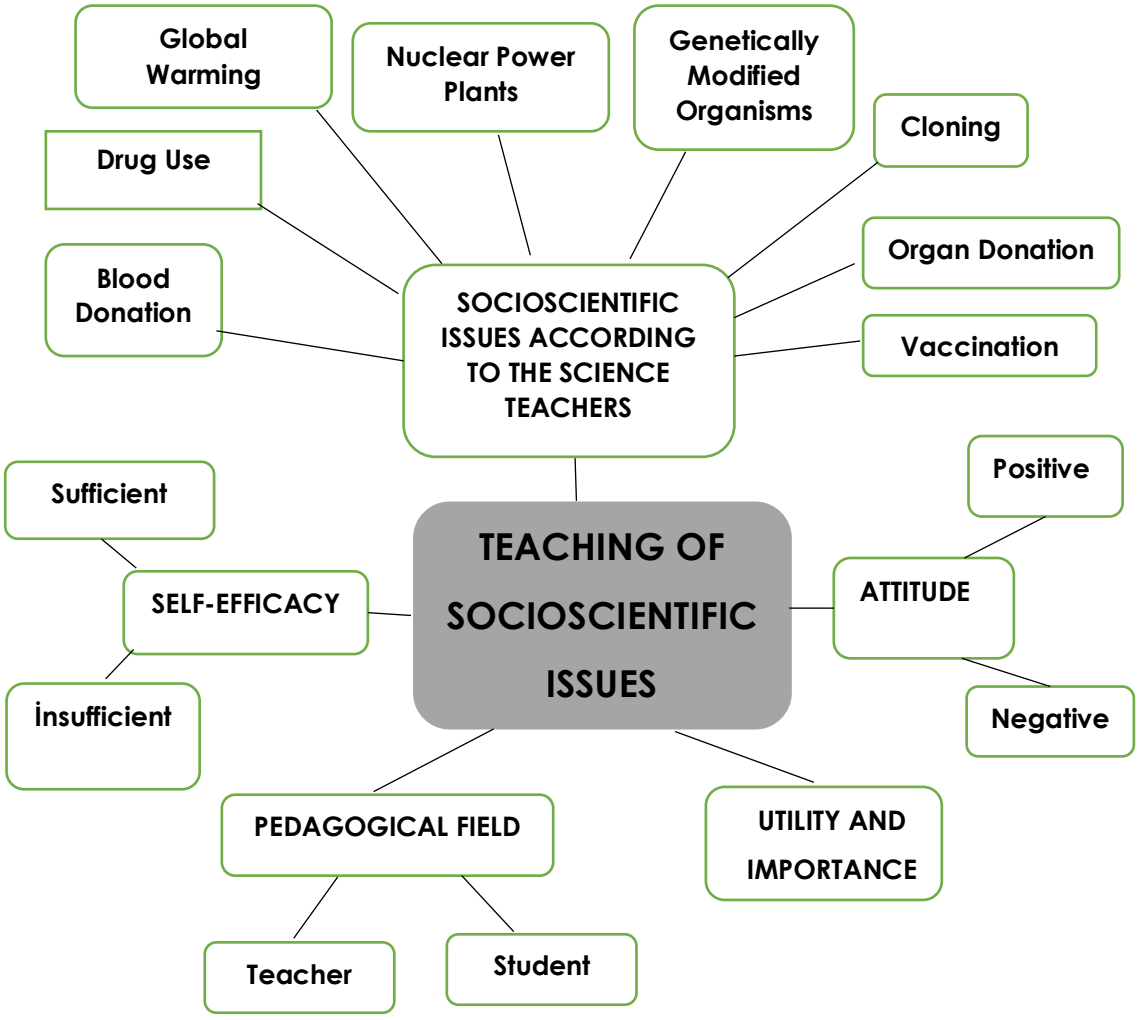

Figure 1. Themes and Sub-Themes aimed at Teaching Socioscientific Issues

As a result of the interviews with the participant science teachers, the topics that occurred to the teachers' mind when they talked about socioscientific issues were; blood donation, cloning, genetically modified organisms, global warming, vaccination, drug use, nuclear power plants, and organ donation. T5 stated "Blood donation, organ donation, global warming, cloning, GMO products, nuclear power plants, vaccination can be given as examples," T2 mentioned "Global warming, GMO products, cloning" as examples of socioscientific issues.

Following the interviews with the science teachers, most of the teachers stated that they had sufficient self-efficacy regarding the "self-efficacy" dimension, which was one of the sub-dimensions of the scale. For instance, T2 said, *"I think I have enough knowledge since there are subjects within the scope of science course content knowledge. Furthermore, I do my research on the internet resources before the lesson and convey it to my students."* On the other hand, T6 said, *"I think I have enough information to be able to transfer the correct knowledge and information to the students and discuss these issues with them. In order to be informed about new relevant advances, I constantly access and research this information from social media, written and visual media. I transfer this knowledge and information, which I have obtained from scientific journals or internet sites to my students. Additionally, I attend training on socioscientific issues. It was very beneficial for me." With all these statements, they emphasized that they considered themselves qualified for the teaching of socioscientific issues.*

Some teachers also considered themselves unqualified regarding the socioscientific issues and teaching. The following statement, *"I do not think I have enough knowledge and information because I did not receive any training on this subject before or during my undergraduate education. Following my graduation, the socioscientific issues started to be discussed more and offered a course at the faculties"*, T1 emphasized his/her lack of self-efficacy.

Following the analysis of teachers' opinions regarding the "attitude" dimension, which was one of the sub-dimensions of the scale, it was evident that the attitudes of the majority of teachers towards socioscientific issues and teaching were positive. For instance, in his/her following statement, *"When I teach any of the socioscientific issues in the class, firstly I find out the ideas of the students about the subject, one by one. In a democratic class, I do not do any grouping as right or wrong when everyone is speaking their mind. Different ideas are likely to arise; our objective here is to lend an ear to all ideas and never judge them"*, T6 emphasized the existence of different ideas that formed the basis of socioscientific issues and that it was not right to judge their thoughts.

The teacher coded T4, on the other hand, with the statement *"Without learning the scientific information that students need to learn as a basis; I think that the socioscientific issues should not be directly included in the teaching process for the students who have not developed basic scientific thinking and critical thinking skills"*, emphasized that the students at the secondary level of education of socioscientific issues did not have sufficient scientific process skills and competencies and developed a negative attitude towards the teaching of socioscientific issues.

Regarding the "pedagogical field competence" dimension, another sub-dimension of the scale, it was clearly observed that teachers primarily emphasized the pedagogical field competencies that their students and themselves should have. For instance, in his/her statement, *"In the first place, I inform them about the subject because the students do not have a good grasp of the subject. Afterwards, I try to visualize the subject using short videos. I usually pay attention to a subject that they can hear around and associate with their own lives. For instance, when I talk about nuclear power plants, I talk about both the positive and negative aspects of it. In the end, I call upon the students to explain what they think about this subject and express their thoughts; and they express their thoughts on a debate platform."* T1 stated that *"it is necessary, initially, to do sufficient research and have knowledge in order to deal with socioscientific issues*. In another teacher's statement, *T5 said, "For a course that includes socioscientific issues, I initially tell the students to research the subject. And then, I reveal the knowledge and information about the subject by creating a discussion with various questions in the class."* With the following statement, *"If I think the ideas will get too extreme, I get expert support. For instance, if the religious aspect of organ donation is going to be discussed, I would like to invite our Religious Culture and Moral Knowledge teacher to the*

classroom and request him/her to inform the class about the subject.", T1 also emphasized the importance of taking expert opinions when required.

Regarding the last sub-dimension of the scale, the "utility, and importance", it was evident that the majority of teachers believed that teaching socioscientific issues was emotionally beneficial and significant.

For instance, T3 said, *"I think that incorporating socioscientific issues within the lesson helps students develop positive attitudes towards science. That way, the students realize that the lesson is not just taught and learned in the classroom, but that the science lesson is intertwined with daily life. In other words, they learn to be respectful to other people who do not think like them. They realize that they have to justify themselves with scientific reasons while having a scientific discussion",* followed by another statement, *"As we deal with the socioscientific issues, there is a discussion platform in the classroom, and the students approach the issues with a critical perspective. Since socioscientific issues are generally issues rooted in real life, students are already familiar with these issues, so they take part in discussions more than ever",* the teachers expressed their views.

The teachers emphasized that the socioscientific issues were of great importance in terms of establishing a positive attitude towards science lessons, thus these issues help the students to get in touch with daily life, teach the students to respect different opinions, help them to gain critical thinking skills, and contribute to scientifically literate individuals.

5 Discussion

In the present study, based on the sub-dimensions of the scale and the arithmetic mean values, the affective tendencies of the sub-dimensions of "self-efficacy", "utility and importance", "pedagogical field competence" were high; regarding the "attitude" sub-dimension, their affective tendencies were moderate. Regarding the average value of all items on the scale, teachers' affective tendencies were generally high. Based on these results, it is possible to say that the affective tendencies of science teachers towards teaching socioscientific issues were generally high. In the interviews conducted with the teachers, they defined the socioscientific issues as scientific issues that emerged within the society, created controversy, left individuals in dilemma. They gave examples related to socioscientific issues such as vaccination, organ transplants, global warming, drug use, nuclear power plants, genetically modified organisms, blood donation, and cloning. The examples in this study were used as examples for SSI in many other studies (Goloğlu, 2009; Nuangchalerm & Kwuanthong, 2010).

As a result of the analyses made considering all scale items, it was concluded that the affective tendencies of science teachers towards teaching socioscientific issues did not differ significantly by the variables of gender, place of work and tenure. However, there was a significant difference by the variable of educational background. Furthermore, it was found that there was a difference between undergraduate-degreed teachers and the doctoral candidate teachers, and that this difference favored doctoral teachers. Throughout this process, the fact that the teachers took courses related to SSI, that they conducted research on these issues, prepared seminars and presentations, had a good expertise of the literature, and were aware of current developments during their doctoral studies period may have caused the affective tendency towards teaching SSI to be high. On the other hand, the result of the statistical analyses implemented considering the sub-dimensions of the scale showed that there was a significant difference in favor of female only in the "attitude" sub-dimension of affective tendencies, signifying that female science teachers had higher affective tendencies in the dimension of attitude.

A study conducted by Erkol & Gül (2020) concluded that there was a significant difference by gender in favor of female. In the present study, it was similarly concluded that the female pre-service teachers had a more detailed perspective and attached importance to SSI compared to the male pre-service teachers (Sakmen & Genç, 2021). There are also studies available in the relevant literature that have found that attitudes towards the SSIs did not differ significantly by gender (Atalay & Çaycı, 2017; Cebesoy & Dönmez Şahin, 2013; Tekin & Aslan, 2019).

It was evident that there was a significant difference in the sub-dimensions of "self-efficacy" and "pedagogical field competence" by the variable of educational background of the

affective tendencies of science teachers. It was concluded that among the teachers with an undergraduate degree, a master's degree and a doctorate degree, there was a significant difference in the self-efficacy sub-dimension in favor of the teachers who were doctoral-candidates.

Furthermore, it was revealed that the significant difference between the teachers with master's degrees and undergraduate degrees was in favor of the teachers with master's degrees. In the pedagogical field competence sub-dimension, with regards to the education variable, between doctoral-candidate teachers and teachers with an undergraduate degree, there was a significant difference in favor of doctoral-candidate teachers. İn their study with biology teachers, Aydin et al. (2021) stated that the teachers with master's degrees and doctoral-candidate teachers incorporated students' participation in the lesson with different activities while teaching SSIs in class. It was clear that postgraduate education contributed to the teachers in terms of offering them the opportunity to follow current approaches and innovations. It is crucially important to offer similar qualifications at the undergraduate level as well.

Based on all sub-dimensions of the scale in relation to the place of work and tenure variables, no significant difference was found. Due to this, it can be concluded that teachers took courses or training on the subject, benefited from the scientific and technological resources, did some research on their own and followed the current events.

Following the interviews with the science teachers to cover the sub-dimensions of the scale, most of the teachers stated that they had sufficient self-efficacy. They stated that they had sufficient knowledge and information about the socioscientific issues and their teaching. They followed social media, written and visual media, scientific researches in order to access new knowledge and information and developments, and attended subject-related trainings. In their study, Sönmez & Kılınç (2012) concluded that the most important factor in teachers' self-efficacy regarding the teaching of SSI was that they had sufficient knowledge of the subject matter. Nevertheless, in this study, some teachers also stated that they regarded themselves unqualified in socioscientific issues and teaching. To their justification, they stated that socioscientific issues just started to be included in the curriculum during and after undergraduate education and they did not have much knowledge and information about the subject. Some studies demonstrated that teachers' insufficiency in socioscientific issues were caused by the problems in the education system, insufficiencies in the curriculum and textbooks, students, families, supportive materials and school facilities (Çopur, 2015; Karahan, 2015).

Regarding the "attitude" dimension as one of the sub-dimensions of the scale, the attitude of the majority of teachers towards socioscientific issues and teaching was positive. In other words, by creating a democratic environment in discussions, students could express their ideas easily without being judged and that they were aware that there was no single absolute truth.

Babacan (2017) concluded that students' critical thinking skills improved in accordance with activities on socioscientific issues in the lesson. Moreover, it was apparent that there was a positive change in students' discussion skills (Öztürk, 2013). Apparently, discussing a topic in the classroom can improve students' thinking skills on socioscientific issues (Evren Yapıcıoğlu & Kaptan, 2018).

In the present study, it was concluded that some teachers had a negative attitude towards the teaching of SSI because the students at the secondary school level did not have sufficient scientific process skills and competencies. However, since 2013, SSI has been included in the science curriculum with relevant learning outcomes. Despite the emphasis placed on SSI in science education in recent years, it is, by and large, a challenge to teach the controversial SSI to teachers. Even though teachers have generally positive attitudes towards teaching SSI in science lessons, the number of teachers who regularly include SSI in science programs is not high (Karahan, 2015).

Regarding the dimension of "pedagogical field competence", the teachers emphasized that primarily, students and themselves should have sufficient knowledge and competence about SSI by conducting necessary research, information, and material support for the lesson, with access to expert assistance as needed. Based on the science lessons conducted on socioscientific issues, it was observed that the conceptual development of students increased (Klosterman & Sadler, 2010). Some studies revealed that the scientific knowledge that students

learnt at school would be permanent as long as it was associated with daily life (Enginar et al., 2002; Yıldırım & Bakırcı, 2020).

Regarding the last sub-dimension of the scale, "utility and importance," the teachers stated that socioscientific issues were of great importance in terms of adopting a positive attitude towards the science lesson. When considering the SSI, the teachers emphasized the importance and utility of teaching socioscientific issues, stating that they were related to daily life, nurturing respect for different opinions, stimulating critical thinking skills, and contributing to the training of scientifically literate individuals. Previous studies illustrate that SSIs were beneficial for students in developing critical thinking skills(Albe, 2008; Gürbüzkol & Bakırcı, 2020).

6 Conclusion

Considering the overall results of the present study, it was concluded that the affective tendencies of science teachers towards teaching SSI were high. Since teachers play a vital role in putting SSI into practice in the classroom, it is crucial to acknowledge that the results of this study supported the fact that science teachers should have sufficient competence and mentality about SSI teaching. Furthermore, it was revealed that the SSI studies generally focused on teacher candidates, and secondary and high school students. Considering that the studies with science teachers are limited, it is expected that the results of the present study will contribute to the relevant literature.

Limitation

Although the study has been carefully designed and implemented, and it has provided us with the expectant result, there are still some inevitable limitations in the study, like the sample of the subjects that is not large enough.

Recommendation

It is necessary to encourage science educators to consider many issues related to SSI teaching in both initial and teacher education. More opportunities should be provided in undergraduate programs in order to increase the knowledge levels of teachers and prospective teachers about SSIs and their self-efficacy in teaching these subjects. To accommodate this, in-service training should be given to teachers. Since studies with science teachers are limited, studies on science teachers should be handled using different methods and techniques.

Acknowledgments

This study was presented as an oral presentation of the Symposium "V. International Symposium on Social Sciences and Educational Sciences,

Conflict of Interest

The researchers declared no conflict of interest.

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