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Comparison of Preservice Science and Social Studies Teachers' Attitudes Towards Socioscientific Issues

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Abstract

In this study, the views and attitudes of pre-service science and social studies teachers towards socioscientific issues were examined. Descriptive research design was used in the study. The quantitative data were collected with the "Attitude Scale towards Socioscientific Issues" and the qualitative data of the research were collected with a questionnaire consisting of 5 open-ended questions. 215 science and 220 social studies teacher candidates participated in the research. While qualitative data were analysed descriptively, SPSS program was used in the analysis of quantitative data. As a result of the research, pre-service teachers did not consider their knowledge of sociological issues sufficient and that there were deficiencies in the education system. As a result of the analyses, a significant difference was uncovered in favour of science teacher candidates in the worry sub-dimension related to socioscientific issues and it was determined that the worry level of science teacher candidates was higher than social teacher teachers.

Keywords: Socioscientific subjects, Attitude, Preservice teachers

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Introduction

Socioscientific issues are complex issues that arise through the transmission of science and technology, often involve ethical, moral, or legal dilemmas, and are not discussed with strict consensus (Nielsen, 2012a; Sadler, Amirshokoohi, Kezampouri and Allspaw, 2006; Walker and Zeidler, 2007). Since these subjects are those that support the cognitive, affective, and social development of individuals in scientific issues that concern society, it is stated that participation of them in the curriculum is a sign of science literacy (Dawson & Venville, 2009). Therefore, it is seen that socioscientific issues are important in the decision-making process of science literacy on social issues related to science. As the content of socioscientific issues consists of situations that we may encounter in daily life, teaching these subjects to students is important in science education (Albe, 2008; Kolsto, 2006; Nielsen, 2012b; Walker & Zeidler, 2007). Understanding socioscientific issues plays an important role in students' making informed decisions on dilemma issues. It has been observed that learning environments based on socioscientific issues make learning science concepts more interesting for students and positively affect the attitudes and motivations towards science lesson (Albe, 2008; Lee & Erdogan, 2007; Parchmann et al., 2006; Zeidler et al., 2009; Klosterman & Sadler, 2010). In the studies conducted Gülhan (2012), Kaya and Sürmeli (2019), it was observed that students' interest in the lesson increased in classrooms where science lessons are taught based on socioscientific issues. North America can be considered where studies and practices on socioscientific issues first appeared. Many studies have been conducted on the teaching of socioscientific issues in North America and these topics have been transferred to science programs in many different states (Topçu, 2015). Since 2013, socioscientific issues have been included in the Science curriculum of the Turkish Ministry of National Education (Topçu et al., 2014). Discussing socioscientific issues in teaching is a way to increase students' interest in science practices. In order to raise students with high social awareness, there is a need for activities integrated with socioscientific issues. Providing teacher education is a prerequisite for our students to participate in scientific discussions on socioscientific issues and to make correct decisions (Cebesoy & Dönmez Şahin, 2013).

Raising individuals who have scientific thinking habits and decision-making skills by using socioscientific issues are among the main objectives of science education. However, when the relevant literature is examined, it is seen that the knowledge and experience of science teachers, who are the practitioners of the program, on socioscientific issues and their teaching are significant. Science teachers stated that their knowledge related to teaching socioscientific issues is insufficient and the reason for this is that the curriculum is not sufficient (Anagün & Özden, 2010). In the study of Yapıcıoğlu (2016), it was emphasized that the acquisitions related to socioscientific issues in the science course curriculum should be increased. Opinions and attitudes of teachers play an important role in the use of socioscientific issues, which have become an important component of science education, in the classroom environment and their appropriate association. It is thought that the

education of the teachers in this subject in their past lives and at the university will have a great impact on their awareness of socioscientific issues and their teaching. Considering that teachers raise individuals who will shape the society, teachers need to be aware and conscious regarding socioscientific issues (Sadler, 2004).

In the studies conducted recently on socioscientific issues, it is seen that science teacher candidates are more prominent in the field of science (Tezel & Günister, 2018; Genç & Genç, 2017). However, although socioscientific issues have a feature that includes the field of science as well as the field of social studies, only science is mainly considered and studied. Although the acquisitions related to socioscientific issues are included in the social studies course curriculum, there are almost no studies determining the opinions and attitudes of social studies teacher candidates on the subject and comparing them with pre-service science teachers (Çepni & Geçit, 2020). In addition, in most of the studies, it is seen that scales are used only within the scope of quantitative research. In this study, it was tried to compare the awareness of both social studies and science teacher candidates against socioscientific issues by using open-ended questions in addition to the scale. Today, when socioscientific issues are so important, it is important to reveal the opinions and attitudes of pre-service science and social studies teachers related to socioscientific issues.

Aim of the Study

The aim of this study is to examine and compare the attitudes of pre-service science and social studies teachers towards socioscientific issues.

Accordingly, perception of socioscientific issues by prospective teachers was seen as a problem. The general problem of the study is the question "What are the views and attitudes of the science and social studies teacher candidates towards socioscientific issues?". In this context, answers for the following sub-problems were sought in the study.

1. What are the opinions of pre-service science and social studies teachers about socioscientific issues?

2. What are the attitudes of pre-service science and social studies teachers about socioscientific issues?

3. Do science and social studies teacher candidates' attitudes towards socioscientific issues differ according to year, department, and gender?

4. Is there a significant relationship between the sub-dimensions of science and social studies teacher candidates' attitudes towards socioscientific issues?

Method

Descriptive research method was used in this study. Descriptive research method is conducted to enlighten a given situation, make evaluations, and reveal possible relationships between events. The main aim of such studies is to describe and explain the situation under study in detail (Yıldırım & Şimşek, 2008). The data in the study were obtained in a quantitative dimension with the attitude scale towards socioscientific issues. In addition, qualitative data were collected from the socioscientific issues opinion survey. The necessary permission document was obtained for the applicability of the study. Data collection tools were applied by the researcher in the classroom for one lesson.

Study Population and Sample

The population of the study consists of the teacher candidates studying at Recep Tayyip Erdogan University Faculty of Education and Trabzon University Fatih Education Faculty in the spring semester of 2018-2019 academic year. The sample of the study consists of 435 pre-service teachers, 215 of which are science and 220 social studies teachers randomly selected from this population. 68.8% of the teacher candidates are female and 31.2% are male. While 49.4% of the teacher candidates participating in the study were science teacher candidates, 50.6% were social studies teacher candidates.

Data Collection Tools

Both quantitative and qualitative data collection tools were used in the study. In the study, "Attitude Scale Towards Socioscientific Issues" developed by Topçu (2010) was used to gather information about the attitudes of teacher candidates towards socioscientific issues. The "Socioscientific Issues Opinion Questionnaire" developed by the researcher was used to gather information about the opinions of the teacher candidates on socioscientific issues. It was aimed to obtain more valid data by using qualitative and quantitative data collection tools.

Socioscientific Issues Opinion Questionnaire

Socioscientific issues opinion questionnaire consists of two parts. In the first part, while information about the gender, department and year variables of pre-service teachers was collected in the personal information form, in the second part, an interview form containing five open-ended questions was prepared in order to determine the opinions of the teacher candidates on socioscientific issues in line with the aims of the study and applied to the pre-service teachers. These questions include what socioscientific issues evoke for them, where they heard from, whether they see their own level of knowledge sufficient or not, whether they can give examples from daily life, whether the courses they have taken in university education are sufficient about socioscientific issues. While preparing the questions regarding this questionnaire, the opinions of two experts in the field of science education were taken.

Attitude Scale Towards Socioscientific Issues

"Attitude Scale Towards Socioscientific Issues" developed by Topçu (2010) was applied in order to determine the attitudes of the teacher candidates participating in the study on socioscientific issues. This scale, which consists of three sub-dimensions and 30 items, is in the 5-point Likert type. It was graded as “1-Strongly disagree”, “2-Disagree”, “3-Undecided”, “4-Agree”, “5-Strongly agree”. Topçu (2010) revealed that the scale consists of three dimensions with Cronbach alpha internal consistency coefficients ranging from 0.70 to 0.90. The internal consistency coefficient of the benefit and importance sub-dimension was 0.90, the internal consistency coefficient in the liking sub-dimension was 0.81, and the internal consistency coefficient in the worry sub-dimension was 0.70 (Topçu, 2010). It is stated that this scale used is valid and reliable by the researcher. In this study, Cronbach alpha internal reliability coefficient was obtained as 0.775. The Cronbach alpha coefficients related to the sub-dimensions are given in Table 1.

Table 1. Internal consistency coefficients by sub-dimensions

Sub-dimension	Items in the Scale	Cronbach alpha
Benefit and importance	1,2,4,9,11,14,15,18,20,21,22,23,25,26,27,28,30	0.786
Liking	6,7,8,10,13,17,24	0.751
Worry	3,5,12,16,19,29	0.762
Whole Scale		0.775

Data Analysis

The answers given in the analysis of qualitative data were analysed descriptively and the results were interpreted. The direct answers given by the pre-service teachers to open-ended questions related to socioscientific issues were expressed as frequencies and percentages. In the analysis of quantitative data, the scores obtained from the scale of attitude towards socioscientific issues were entered into the SPSS software and necessary statistical analyzes were made. The significance level was accepted as 0.05 in the application of statistical processes. t-test was used to determine whether the candidates' attitudes towards socioscientific issues differed, one-way analysis of variance to determine whether the attitudes differ according to class level, two-way analysis of variance to determine whether there is a common effect of department-class level and department-gender in the differentiation of these attitudes. At the same time, Pearson correlation analysis was used to determine whether there was a relationship between the sub-dimensions of attitudes towards socioscientific issues.

Findings

In this study, it was aimed that the views and attitudes of pre-service science and social studies teachers towards socioscientific issues were examined. Findings obtained from the study are presented according to the sub-problems.

Findings Regarding the First Sub-Problem

5 open-ended questions were asked in order to determine the views of pre-service teachers on socioscientific issues. Findings for these questions are given below. The answers given to the Question 1 *"Have you ever heard of socioscientific issues? Where from?"* are presented in Table 5.

Table 2. Responses of pre-service science and social studies teachers to hear about socioscientific issues

	I heard		I haven't heard		Where did I hear
Department/ Year	**f**	**%**	**f**	**%**	**f**
Science 1st Year	12	22.2	42	77.8	Internet (12), television (10), school (6), books (4)
Science 2nd Year	35	68.7	16	31.3	Internet (30), television (25), school (23), books (15)
Science 3rd Year	52	89.7	6	10.3	Internet (47), television (43), project (32), book (23)
Science 4th Year	44	84.7	8	15.3	Internet (41), school (35), television (29), books (15)
Social Studies 1st Year	22	38	36	62	Internet (19), television (15), books (11), school (9)
Social Studies 2nd Year	32	55.1	26	44,9	Television (29), internet (26), school (15), books (12)
Social Studies 3rd Year	25	48	27	52	Internet (22), television (18), school (13), books (11)
Social Studies 4th Year	19	36.6	33	63.4	Internet (17), television (13), school (12), books (10)

According to Table 2, it is seen that teacher candidates heard socioscientific issues at certain rates through various channels such as internet, television, school, project and book. While the percentages of hearing these topics increased from 1st year to 4th year among pre-service science teachers, it was found that social studies teachers remained at a certain rate and did not increase.

The answers given to Question 2 *"What comes to your mind when it comes to socioscientific issues? What does it mean to you?"* are given.

Table 3. The answers of pre-service science teachers about socioscientific issues

	1st Year		2nd Year		3rd Year		4th Year	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Global Warming	45	**83.3**	**45**	**88.2**	**53**	**91.3**	**34**	**65.3**
GMO	48	**88.8**	**38**	**74.5**	**30**	**51.7**	**49**	**94.2**
Science	32	59.2	12	23.5	29	50	13	25
Cloning	9	16.6	**38**	**74.5**	**40**	**68.9**	**34**	**65.3**
Environment	10	18.5	5	9.8	13	22.4	15	28.9
Nuclear Energy	**40**	**74**	**48**	**94.1**	**44**	**75.8**	**43**	**82.7**
Society	14	26	6	11.7	13	22.4	9	17.3
Discussion	12	22.2	14	27.4	11	18.9	9	17.3
HEPP	7	12.9	**30**	**58.9**	**38**	**65.5**	**47**	**90.3**
Geography	4	7.4	9	17.6	2	3.4	1	1.9
Organ Donation	5	9.2	14	27.4	**34**	**58.6**	**38**	**73**

Examining the answers from science teacher candidates in Table 3, it is seen that the important socioscientific issues such as global warming, GMO, cloning, nuclear energy, HEPP, organ donation are expressed at high rates from 1st grade to 4th grade.

Table 4. The answers of pre-service social studies teachers about socioscientific issues

	1st Year		2nd Year		3rd Year		4th Year	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Sociology	23	39.7	25	43.1	20	38.4	17	32.7
Society	21	36.2	21	36.2	32	61.5	13	25
Science	19	32.8	10	17.2	26	50	31	59.6
Geography	19	32.8	21	36.6	21	40.3	21	40.3
Culture	14	24.1	15	25.9	21	40.3	22	42.3
Philosophy	27	46.5	24	41.3	19	36.5	21	40.3
GMO	**17**	**29.3**	**21**	**36.2**	**21**	**40.3**	**19**	**36.5**
History	30	51.8	26	44.9	21	40.3	18	34.6
Global Warming	**19**	**32.8**	**4**	**6.9**	**18**	**34.6**	**27**	**51.9**
Cloning	**7**	**12.6**	**7**	**12.6**	**14**	**27**	**12**	**23.7**
Discussion	10	17.2	14	24.1	32	61.5	25	48.7

When the responses received from social studies teacher candidates are examined in Table 4, it is seen that only topics such as global warming, GMO, cloning, which are among the socioscientific issues, are expressed at lower rates compared to the science teacher candidates from 1st grade to 4th grade. In other answers, they gave more general answers by making associations with the departments.

The answers given to the Question 3 *"As a teacher candidate, how do you evaluate your own level of knowledge on socioscientific issues? Do you see enough? Why is that?"* are presented below.

Table 5. The answers of pre-service science and social studies teachers about their knowledge level on socioscientific issues

	Yes		No		
Department/Year	**f**	**%**	**F**	**%**	**Why?**
Science 1st Year	6	11.1	48	88.9	Lack of knowledge Deficiencies in the education system
Social Studies 1st Year	4	6.9	54	93.1	Lack of knowledge Deficiencies in the education system
Science 2nd Year	9	17.7	42	82.3	Lack of knowledge Not following current issues
Social Studies 2nd Year	8	13.8	50	86.2	Deficiencies in the education system
Science 3rd Year	23	39.7	35	60,3	Lack of knowledge Deficiencies in the education system
Social Studies 3rd Year	4	7.7	48	92.3	Lack of knowledge Not following current issues
Science 4th Year	25	48	27	52	Lack of knowledge Not following current issues
Social Studies 4th Year	6	11.6	46	88.4	Deficiencies in the education system

According to Table 5, as the year increases, there is an increase in the number of pre-service science teachers who think their knowledge level about socioscientific issues is sufficient, while the number of social studies teacher candidates has not increased. The pre-service teachers who did not consider themselves sufficient about socioscientific issues presented reasons such as lack of knowledge, memorization-oriented work for the exam, deficiencies in the education system, inability to follow up-to-date topics, and lack of research as the factors that caused this.

The answers given to Question 4 *"Can you give an example to a socioscientific issue from your daily life?"* are presented below.

Table 6. The answers of science teacher candidates about the place of socioscientific issues in your daily life

	1st Year		2nd Year		3rd Year		4th Year	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
HEPP-Related Studies	**40**	**74.7**	**38**	**74.5**	**36**	**62**	**40**	**76.9**
GMO-Related Studies	**21**	**38.7**	**29**	**56.9**	**32**	**55.1**	**32**	**61.5**
Organ Donation Studies	10	18.5	17	33.3	19	32.7	**30**	**57.7**
Scientific Applications	12	22.2	14	27.4	21	36.6	15	28.9
Stem Cell Studies	9	16.6	**27**	**52.9**	13	22.4	**21**	**40.3**
Health Studies	7	12.9	13	25.5	26	44.8	**24**	**46.1**
Social Problems	14	25.9	12	23.5	17	29.3	12	28.9

According to Table 6, it is seen that science teacher candidates give more examples including studies on GMO, HEPP, organ donation, stem cell and health from the 1st year.

Table 7. The answers of social studies teacher candidates about the place of socioscientific issues in your daily life

	1st Year		2nd Year		3rd Year		4th Year	
	f	**%**	**f**	**%**	**f**	**%**	**f**	**%**
Health Studies	**35**	**60.3**	**29**	**50**	**31**	**59.7**	**29**	**55.7**
Social Problems	19	32.7	**23**	**39.7**	**30**	**57.7**	**27**	**51.9**
Scientific Applications	17	29.3	**27**	**46.5**	**29**	**55.8**	**34**	**65.3**
GMO-Related Studies	7	12.6	8	13.8	6	11.5	8	15.3
HEPP-Related Studies	5	8.6	4	6.9	3	5.8	5	9.6
Organ Donation Studies	4	6.9	7	12.6	5	9.6	6	11.5
Stem Cell Studies	2	3.4	4	6.9	7	13.4	9	17.3

According to Table 7, it is seen that social studies teacher candidates emphasize that they are related to health, society and science rather than GMO, HES, organ donation, stem cell.

The answers given to the Question 5 *"Do you think that the courses you have taken in university education are sufficient on socioscientific issues? Why is that? "* are presented in Table 8.

Table 8. The answers of pre-service science and social studies teachers about sufficiency of courses on socioscientific issues

Department/ Year	Yes f	Yes %	No f	No %	Why?
Science 1st Year	6	11.1	48	88.9	We lack knowledge because we do not follow current topics.
Social Studies 1st Year	18	31,3	40	68.7	Since the theoretical course density is high, we cannot find a medium to discuss such topics.
Science 2nd Year	10	19,6	40	80,4	We heard the concept of socioscientific issues mostly from the projects we participated in.
Social Studies 2nd Year	9	15.5	49	84,5	We lack knowledge on these socioscientific issues because we work with an exam focus.
Science 3rd Year	21	36.2	38	63,8	The courses are handled without any details. There is a system based on memorization, we do not have enough knowledge since there is no discussion environment in the lesson.
Social Studies 3rd Year	5	9,6	47	90,4	We cannot follow current topics. The lecture is taught on the slide, we are not sufficient in socioscientific issues since there is no discussion environment.
Science 4th Year	25	48.7	27	51,3	Since the intensity of the theoretical courses is high, we do not have much information about these subjects.
Social Studies 4th Year	10	19.2	42	80,8	We do not have enough knowledge about socioscientific issues because we work with an exam focus.

According to Table 8, pre-service science teachers' perception of the lessons regarding socioscientific issues as sufficient increases as the year increases. Social studies teacher candidates have a much lower rate of seeing sufficient. However, there is a general deficiency in both cases. Teacher candidates who do not consider the courses taken on socioscientific issues sufficient presented the reasons as failure to follow up-to-date topics, having an education system based on memorization, having a high class intensity for the exam, not having a discussion environment in the lessons, lecturing based on memorization without details, not providing enough information about general concepts.

Findings Regarding the Second Sub-Problem

In order to determine whether the attitudes of science and social studies teacher candidates towards socioscientific issues differed, independent t-test was applied for each sub-dimension. The results obtained are presented in Table 9.

Table 9. T test results of the attitudes towards socioscientific issues based on the variable of the department studied

Sub Dimensions	Science Teacher Candidates			Social Studies Teacher Candidates			Sd	t	p
	N	x̄	SS	N	x̄	SS			
Benefit - Importance	215	3.68	0.47	220	3.63	0.46	433	0.937	0.349
Liking	215	3.25	0.54	220	3.24	0.51	433	0.124	0.901
Worry	215	2.57	0.65	220	2.40	0.71	433	2.575	0.010

According to the analysis results, significant difference was not found in the utility and importance sub-dimension of socioscientific issues [t(433)=0,937, p=0,349>0,05] and in the liking sub-dimension of socioscientific issues [t(433)=0,124, p=0,901>0,05]. On the other hand, a significant difference was observed in favour of pre-service science teachers in the worry towards socioscientific issues [t(433)=2,575, p=0,010<0,05]. Accordingly, it was determined that the worry level of the science teacher candidates towards socioscientific issues was higher than the social studies teacher candidates.

Findings Regarding the Third Sub-Problem

One-way ANOVA test was applied for each sub-dimension in order to determine whether the attitudes of science and social studies teacher candidates towards socioscientific issues differ according to year, department, and gender. The results obtained are presented in Table 10.

Table 10. One-way ANOVA results of attitudes towards socioscientific issues according to the variable of the year of education

Sub Dimensions	Year	N	X	SS	Sd	F	p	The Source of Significant Difference (Tukey)
Benefit and	1st Year	112	3.56	0.45	3	7.557	0.000	3>1
Importance	2nd Year	108	3.56	0.47	431			3>2
	3rd Year	110	3.72	0.42				4>1
	4th Year	105	3.80	0.48				4>2
	Total	435	3.65	0.46				
Liking	1st Year	112	3.13	0.53	3	5.868	0.001	4>1
	2nd Year	108	3.16	0.51	431			4>2
	3rd Year	110	3.28	0.46				
	4th Year	105	3.40	0.55				
	Total	435	3.24	0.52				
Worry	1st Year	112	2.45	0.70	3	0.624	0.600	-
	2nd Year	108	2.46	0.65	431			
	3rd Year	110	2.50	0.73				
	4th Year	105	2.56	0.66				
	Total	435	2.49	0.68				

According to the analysis results, a significant difference was found in terms of year in the utility and importance sub-dimension of socioscientific issues [F (3,431) = 7,557, p = 0,000 <0,05] and in the liking of socioscientific issues [F (3,431) = 5,868, p = 0,001 <0,05]. Tukey analysis was conducted to determine which class or classes the differentiation originated from. As a result of the analysis, it was determined that the scores of the benefit and importance sub-dimension of socioscientific issues of the third and fourth-year pre-service teachers were significantly higher than the pre-service teachers studying in the first and second year. It was determined that the scores of the 4th-year teacher candidates' liking socioscientific issues sub-dimension were significantly higher than the pre-service teachers studying in the first and second year. On the other hand, no significant difference was found in the worry subscale [F (3,431) = 0.624, p = 0.600> 0.05].

Two-way ANOVA test was applied to determine whether there is a common effect of department and year in the differentiation of science and social studies teacher candidates' attitudes towards socioscientific issues. The results obtained are presented below. Table 11 shows the average of the scores the teacher candidates got from the sub-dimensions of attitudes towards socioscientific issues.

Table 11. The average of the sub-dimensions of socioscientific issues related to the department and year variables of teacher candidates.

Department	Year	N	x̄(SS) Benefit- importance	x̄(SS) Liking	x̄(SS) Worry
Science	1st Year	54	3,51(0,503)	3,13(0,591)	2,65(0,670)
Teacher	2nd Year	50	3,53(0,507)	3,16(0,549)	2,63(0,574)
Candidates	3rd Year	57	3,81(0,389)	3,32(0,471)	2,53(0,670)
	4th Year	54	3,83(0,388)	3,35(0,530)	2,50(0,688)
	Total	215	3,68(0,470)	3,24(0,541)	2,57(0,652)
Social Studies	1st Year	58	3,59(0,407)	3,14(0,485)	2,26(0,682)
Teacher	2nd Year	58	3,58(0,446)	3,16(0,491)	2,30(0,689)
Candidates	3rd Year	53	3,62(0,440)	3,23(0,453)	2,46(0,810)
	4th Year	51	3,76(0,568)	3,44(0,577)	2,62(0,632)
	Total	220	3,63(0,469)	3,24(0,513)	2,40(0,715)

Two-way ANOVA test was applied for each sub-dimension regarding whether the difference between the scores obtained from pre-service teachers was significant. Two-way ANOVA results regarding the significance of the scores obtained by the teacher candidates from the benefit and importance sub-dimension for socioscientific issues are given in Table 12.

Table 12. Two-way ANOVA results in the benefit and importance sub-dimension of pre-service teachers for socioscientific issues

	sd	Squares average	F	p
Department	1	0.126	0.602	0.438
Year	3	1.588	7.563	0.000
Department/Year	3	0.395	1.880	0.132

According to Table 12, it was seen that the effect of pre-service teachers on the scores of the utility and importance sub-dimension is not significant [F (1,434) = 0,602, p = 0,438> 0,05], the effect of the course level on the benefit and importance sub-dimension was significant [F (3,434) = 7,563, p = 0,000 <0.05]. Tukey analysis was conducted to determine the classes among which this difference exists. According to the results of the analysis, it was seen that the scores obtained from the benefit and importance sub-dimension of the teacher candidates studying in the 3rd and 4th years were higher than those of the 1st and 2nd years. In addition, it was found that there was no common effect on the benefit and importance sub-dimension of the department-class level interaction [F (3,434) = 1,880, p = 0.132> 0.05].

The results of two-way ANOVA regarding the significance of the difference between the scores obtained by the teacher candidates from the subscale of liking socioscientific issues are given in below.

Table 13. Two-way ANOVA results in the liking sub-dimension of pre-service teachers for socioscientific issues

	sd	Squares average	F	p
Department	1	0.001	0.002	0.962
Year	3	1.583	5.867	0.001
Department/Year	3	0.141	0.524	0.666

According to Table 13, it was seen that the effect of pre-service teachers' departments on the scores of the liking sub-dimension towards socioscientific issues was not significant [F(1,434)=0,002, p=0,962>0,05], it was seen that the effect of year on the liking sub-dimension was significant [F(3,434)=5,867, p=0,001<0,05]. Tukey analysis was conducted to determine the classes among which this difference exists. According to the results of the analysis, it was seen that the scores of the 4th-year teacher candidates from the liking sub-dimension were higher than those of the 1st and 2nd years. In addition, it was found that there was no common effect on the subscale of liking in the department-year interaction [F (3,434) = 0.524, p = 0.666> 0.05].

Two-way ANOVA results regarding the significance of the difference between the scores of the pre-service teachers in the worry sub-dimension towards socioscientific issues are given in below.

Table 14. Two-way ANOVA results in the worry sub-dimension of pre-service teachers for socioscientific issues

	sd	Squares average	F	p
Department	1	2.879	6.209	0.013
Year	3	0.256	0.551	0.648
Department/Year	3	1.488	3.209	0.023

According to Table 14, it was seen that the effect of pre-service teachers on the worry sub-dimension scores of their departments is significant [F (1,434) = 6,209, p = 0,013 <0,05], the effect of year on the worry sub-dimension was not significant [F (3,434) = 0.551, p = 0.648> 0.05]. In addition, the common effect of the department-class level interaction on the worry sub-dimension was found to be significant [F (3,434) = 3.209, p = 0.023 <0.05]. Considering the average of the department in the worry towards socioscientific issues given in Table 14, it was seen that the science teacher candidates were 2.57, and the social studies teacher candidates average was 2.40. It was found that the worry level of science teacher candidates towards socioscientific issues was higher.

Two-way ANOVA test was applied for each sub-dimension in order to determine whether there is a common effect of department and gender in the differentiation of pre-service teachers' attitudes towards socioscientific issues. The average of the scores they got from the sub-dimensions of the attitudes towards socioscientific issues are given in Table 15.

Table 15. The average of the sub-dimensions of socioscientific issues related to the department and gender variables of teacher candidates.

Department	Gender	N	$\bar{x}$(SS) (Benefit-importance)	$\bar{x}$(SS) (Liking)	$\bar{x}$ (SS) (Worry)
Science Teacher Candidates	Female	147	3,69(0,452)	3,20(0,514)	2,52(0,636)
	Male	68	3,64(0,508)	3,34(0,589)	2,68(0,679)
	Total	215	3,68(0,470)	3,24(0,541)	2,57(0,652)
Social Studies Teacher Candidates	Female	152	3,67(0,449)	3,24(0,494)	2,30(0,677)
	Male	68	3,55(0,504)	3,22(0,555)	2,64(0,748)
	Total	220	3,63(0,469)	3,24(0,513)	2,40(0,715)

According to the data in Table 15, a two-way ANOVA test was applied for each sub-dimension regarding whether the difference between the scores obtained from pre-service teachers was significant or not. Two-way ANOVA results regarding the significance of the scores obtained by the teacher candidates from the benefit and importance sub-dimension for socioscientific issues are given in below.

Table 16. Two-way ANOVA results in the benefit and importance sub-dimension of pre-service teachers for socioscientific issues

	sd	Squares average	F	p
Department	1	0.290	1.318	0.252
Gender	1	0.706	3.212	0.074
Department/gender	1	0.110	0.500	0.480

According to Table 16, it was found that the departments of the teacher candidates [F(1,434)=1,318, p=0,252>0,05], the gender variable [F(1,434)=3,212, p=0,074>0,05] and the

department-gender interaction [F(1,434)=0,500, p=0,480>0,05] had no significant effect on the benefit and importance sub-dimension.

The results of two-way ANOVA regarding the significance of the difference between the scores obtained by the teacher candidates from the subscale of liking socioscientific issues are given in below.

Table 17. Two-way ANOVA results in the liking sub-dimension of pre-service teachers for socioscientific issues

	sd	Squares average	F	p
Department	1	0.120	0.431	0.512
Gender	1	0.288	1.039	0.309
Department/gender	1	0.595	2.145	0.144

According to Table 20, it was found that the departments of the teacher candidates [F(1,434)=0,431, p=0,512>0,05], the gender variable [F(1,434)=1,039, p=0,309>0,05] and the department-gender interaction [F(1,434)=2,145,p=0,144>0,05] had no significant effect on the liking sub-dimension.

Two-way ANOVA results regarding the significance of the difference between the scores obtained by the teacher candidates are given in Table 18.

Table 18. Two-way ANOVA results in the worry sub-dimension of pre-service teachers for socioscientific issues

	sd	Squares average	F	p
Department	1	1.657	3.630	0.057
Gender	1	5.649	12.374	0.000
Department/gender	1	0.782	1.714	0.191

According to Table 18, it was seen that the effect of pre-service teachers on the worry sub-dimension scores of their departments is not significant [F (1,434) = 3,630, p = 0.057> 0.05], The effect of gender variable on worry sub-dimension was significant [F (1,434) = 12,374, p = 0,000 <0,05]. Considering the averages given in Table 18, it was seen that the scores of males in the sub-dimension of worry towards socioscientific issues were higher in both departments. In addition, it was found that the department-gender interaction [F (1,434) = 1714, p = 0.191> 0.05] did not have a significant effect on the worry sub-dimension.

Findings Regarding the Fourth Sub-Problem

Pearson correlation test was applied to determine whether there is a relationship between the sub-dimensions of science and social studies teacher candidates' attitudes towards socioscientific issues. The results obtained are presented in Table 19.

Table 19. Pearson correlation analysis results of the relationship between the sub dimensions of teacher candidates' attitudes towards socioscientific issues

		Benefit-Importance	Liking	Worry
Benefit-Importance	r	1		
	p			
Liking	r	0,597**	1	
	p	0.000		
Worry	r	-0,228**	0.016	1
	p	0.000	0.743	

**0,01 N=435

When the results of Pearson correlation analysis between sub-dimensions of science and social studies teacher candidates' attitudes towards socioscientific issues are examined according to Table 19, a moderately positive (0.597) significant relationship was found [r (435) = 0.597, p <0.05] between benefits and importance of sub-dimensions of socioscientific issues and liking. A negative and low level (-0.228) relationship [r (435) = - 0.228, p <0.05] was found between benefits and importance of sub-dimensions of socioscientific issues and worry. No relationship was found between liking and worry [r (435) = 0.016, p> 0.05], which are sub-dimensions of socioscientific issues.

Discussion and Conclusion

In this part of the research, science and social studies teacher candidates' views and attitudes towards socioscientific issues were presented with discussed in the context of sub-problems.

Discussion and Results Regarding the First Sub-Problem

In the first question, it was observed that 55.4% (143 science, 98 social studies) of a total of 435 pre-service teachers who participated in the study had heard about socioscientific issues before, and 44.6% (72 science, 122 social studies) did not. However, it is noteworthy that pre-service science teachers are more likely to be aware of the subjects than social studies teacher candidates are. In both departments, pre-service teachers stated that they heard information about socioscientific issues from the internet, television, school environment, magazines and books, and the projects they participated in. When the data obtained are examined, it is seen that the pre-service teachers learned about socioscientific issues from many different sources, but mostly from the media (internet, TV), and least from books and magazines. In the study conducted by Eş et al. (2016), it is stated that the most important source of information for teacher candidates on socioscientific issues is the media, and the least information is obtained from scientific sources. In the studies of Atasoy et al. (2018), which is a similar study, they stated that the information related to socioscientific issues was mostly learned from the media. In the study conducted by Alaçam-Akşit (2011), it was determined that, in parallel with the findings obtained, classroom teacher candidates mostly used the internet to obtain information on socioscientific issues. As seen in previous studies, most of the information on socioscientific issues is obtained from the media.

When the answers given to the second question are examined, it is seen that the answers given by pre-service science teachers mostly are GMO, HEPP, organ donation, global warming, cloning, nuclear power plants, while the answers given by the pre-service social studies teachers are culture, philosophy, history, geography, global warming, GMO, organ donation, nuclear energy. Here, it is seen that pre-service teachers associate socioscientific issues with their own departments. It was observed that pre-service science teachers used more specific conceptual expressions to associate the subjects with socioscientific issues, while social studies teacher candidates used more general and superficial expressions. The common answers given in both departments are issues such as GMO, nuclear energy, and HEPP. In parallel with this finding, Bakırcı et al. (2018) stated in their study that subjects such as nuclear energy, HEPP, GMO were frequently featured in the media and that their students had an idea about these issues.

When the answers to the third question were examined, it was seen that the rate of those who considered their knowledge level about socioscientific issues sufficient was 19.3% (62 science, 22 social studies), while the rate of those who did not consider it sufficient was 80.7% (153 science, 198 social studies). While it was observed that as the year of science teacher candidates increased, the sufficiency of their knowledge level increased, while no significant difference was observed in the knowledge level sufficiency of social studies teacher candidates as their year increased. It can even be said that there is no change in the sufficiency of social studies teacher candidates regarding socioscientific issues during the four-year education period. The pre-service science and social studies teachers presented reasons such as the deficiencies in the education system, the teaching of memorization-oriented lessons, and the lack of research and knowledge on the subject as the reasons for the deficiencies in their knowledge. In the study conducted by Anagün and Özden (2010), it was stated that teachers lacked knowledge and experience on socioscientific issues. Similarly, in the study conducted by Turan (2012), it is seen that there is no significant difference in the comparisons between the classes regarding the knowledge levels of social studies teacher candidates about socioscientific issues.

When the answers to the fourth question are examined it was determined that social studies teacher candidates gave superficial answers such as history, education, society and health fields without going into in-depth concepts, while the science teacher candidates stated that socioscientific issues are involved in social problems in daily life, wherever science exists, issues related to nuclear power plants, GMOs, cloning, organ transplantation, drug use, which create dilemmas and controversial events. This fact consistently overlaps with the answers received from pre-service teachers in other questions. In the study conducted by Kapıcı and İlhan (2016) on nuclear power plants, it was stated that different departments dominate the subject from different bases. For this reason, they stated that pre-service teachers had more knowledge about scientific subjects and that social teacher candidates mainly looked at the subject as economical and useful.

When the answers to the fifth question were examined, it was determined that the rate of those who considered university education sufficient was 23.9% (62 science knowledge, 42 social studies), while the rate of those who did not consider it sufficient was 76.1% (153 science, 178 social studies). This situation shows that science teacher candidates are more competent than social studies teacher candidates than the education they received at university. The answers given by the teacher candidates who regard university education inadequate as a reason for this show similarities with each other. The answers given are mostly in the form of not following the agenda, the lessons being far from current issues, focusing on exam-based memorization, not including topics related to socioscientific issues in the books, and not creating a discussion environment on socioscientific issues in courses. In a similar study by Kılıç (2019), it was revealed that socioscientific issues are cursory in the lessons, teachers and students do not have sufficient knowledge on these issues, and sections on socioscientific issues are missing in the textbooks. In a study conducted by Yapicioglu and Aycan (2018), it was determined that the activities that pre-service science teachers participated in related to socioscientific issues improved their reasoning and reasoning.

Discussion and Results Regarding the Second Sub-Problem

In order to determine whether the science and social studies teacher candidates' attitudes towards socioscientific issues differed, the t-test was performed and the findings were interpreted. When the data were examined, it was determined that there was no significant difference on the benefit and importance and liking sub-dimension of socioscientific issues according to the department variable studied. On the other hand, a significant difference was observed in favour of pre-service science teachers in the worry towards socioscientific issues. In the study conducted by Tekin and Aslan (2019), it was stated that pre-service science teachers had a higher attitude in terms of benefit and importance from the sub-dimensions of socioscientific issues and the dimensions of worry. Unlike the findings of this study, Yerdelen et al. (2018) concluded that there is a difference between the benefit, importance and liking dimensions of socioscientific issues according to the department variable, and there is no difference in the worry sub-dimension. If the results obtained in this study are summarized, it was seen that the science and social studies teacher candidates benefit from the sub-dimensions of socioscientific issues, and there is no difference between their importance and liking levels, and the pre-service science teachers have a higher attitude in the worry sub-dimension. The high level of worry of pre-service science teachers may be due to the fact that they realized the socioscientific issues in the courses they took at the university and realized their difficulties and that these issues are controversial and dilemma issues. It is also understood from the detailed answers they gave to open-ended questions that pre-service science teachers were more familiar with the subjects related to socioscientific issues.

Discussion and Results Regarding the Third Sub-Problem

ANOVA test was conducted for each sub-dimension in order to determine whether year, department, and gender had an effect on the attitudes of science and social studies teacher candidates towards socioscientific issues and the results were interpreted. According to the results, a significant difference was found between the scores obtained from the benefit and importance sub-dimension and the year. According to this differentiation, it was determined that the attitudes of the teacher candidates studying in the 3rd and 4th years in the dimension of benefit and importance were significantly higher than those studying in the 1st and 2nd years. In the beginning, it was observed that social studies teacher candidates had a higher average in the benefit and importance sub-dimension of socioscientific issues, but when it came to the fourth year, it was determined that the differentiation among pre-service science teachers was higher. A significant difference was found between the scores obtained from the another sub-dimension, liking, and the year. According to this differentiation, it was determined that the attitudes of the teacher candidates studying in the 4th year were significantly higher than the ones studying in the 1st and 2nd year. While a sudden increase was observed in the liking sub-dimension scores of pre-service science teachers studying in the 3rd year, this increase was observed in the pre-service teachers studying in the 4th year. According to the results, it is seen that as the class level increases, the interest and importance of socioscientific issues increase. Similar to the findings of this study, Yolagiden (2017) stated that there is a meaningful differentiation when the attitudes of teacher candidates towards socioscientific issues are examined according to the level of education. On the contrary, no significant difference was found between the scores obtained from the worry sub-dimension and the year. Sıbıç (2017) conducted a study with 3rd and 4th-year science teacher candidates in order to determine the opinions of pre-service science teachers about socioscientific issues. As a result of the study, it was revealed that most of the pre-service teachers had an idea related to socioscientific issues and were able to define socioscientificity. As a result of Türksever's (2019) study, it was determined that the attitudes and opinions of students studying in science and social studies teaching departments towards socioscientific issues are more positive as their year increases.

Two-way ANOVA test was applied to determine whether there is a common effect of department and year in the differentiation of science and social studies teacher candidates' attitudes towards socioscientific issues for each sub-dimension. It was determined that the department-year interaction had no effect on the benefit and importance and liking sub-dimension, whereas it had an effect on the worry sub-dimension. Considering the average scores of both departments given in Table 14 from the worry sub-dimension, it was found that the pre-service science teachers' level of worry towards socioscientific issues was higher. In the study conducted by Tekin and Aslan (2019), it was concluded that the worry level of pre-service science teachers was higher than the pre-service teachers in other departments. The higher awareness of pre-service science teachers related to

socioscientific issues as a result of the courses they took at the university may have led to a high level of worry.

Two-way ANOVA test was applied to determine whether there is a common effect of department and gender in the differentiation of science and social studies teacher candidates' attitudes towards socioscientific issues for each sub-dimension. As a result of the analysis, it was determined that the department-gender interaction of the teacher candidates did not have a significant effect on the benefit and importance, liking and worry dimensions of the sub-dimensions of socioscientific issues. Similar to the findings of these studies, Cebesoy and Dönmez Şahin (2013) found in their study that the gender and year variables of pre-service teachers had no effect on attitudes towards socioscientific issues. Similarly, Keefer (2003) concluded that gender is not very effective in making decisions about socioscientific issues.

Discussion and Results Regarding the Fourth Sub-Problem

In order to reveal the relationship between the sub-dimensions of science and social studies teacher candidates' attitudes towards socioscientific issues, Pearson correlation analysis was performed and the results were interpreted. When the data are examined, it is seen that there is a moderately positive significant relationship between the benefit and importance dimensions and the liking dimension. A low level negative relationship was found between the benefit and importance dimensions and the worry dimension. However, no significant relationship was found between the liking sub-dimension and the worry dimension. Similar to these results, Cebesoy and Dönmez Şahin (2013) found a positive and significant relationship between benefit and importance and liking sub-dimensions, while a negative and low-level relationship was found between benefit and importance and worry sub-dimension.

Accordingly, the results obtained from the study can be summarized as follows:

1. It was determined that the science and social studies teacher candidates participating in the study learned the information about socioscientific issues mostly from the media (internet, television).

2. It was concluded that the awareness of science teacher candidates is higher than social studies teacher candidates. The fact that a larger proportion of social studies teacher candidates compared to science teacher candidates stated that they did not see their knowledge level on socioscientific issues sufficient, which supports this situation. They attribute this situation to justifications such as the deficiencies in the education system, the existence of an exam-based memorization system, and the fact that current issues are not followed.

3. According to the department variable, there was no significant difference between the benefit-importance sub-dimension and the liking sub-dimension of socioscientific issues. On the other hand, a significant difference was observed in favor of pre-service science teachers in the worry.

4. According to the year variable, a significant difference was found in the benefit-importance sub-dimension and liking sub-dimension of socioscientific issues. According to the analysis results, it was determined that the benefit and importance sub-dimension scores of the third- and fourth-years pre-service teachers were higher than the pre-service teachers studying in the first and second years. It was found that the liking sub-dimension scores of the fourth-year teacher candidates were higher than those who were studying in the first and second year. On the other hand, no significant difference was found in the worry sub-dimension.

5. While it was observed that the interaction of department and year had no effect on the benefit-importance and liking sub-dimension, it was found that it had a significant effect on the worry sub-dimension and the worry level of pre-service science teachers was higher.

6. It was determined that the joint effect of department and gender does not have an effect on the levels of benefit-importance, liking and worry from the sub-dimensions of socioscientific issues.

7. From the subscales of socioscientific subjects, a significant positive relationship was found between utility importance and love and a negative relationship was found between utility importance and worry.

Recommendations

1. In the lectures given at the university, science and social studies teacher candidates should be given more space to develop their decision-making skills towards socioscientific issues in order for them to look at socioscientific issues from different perspectives.

2. In order to increase the awareness of social studies teacher candidates and teachers, more sample activities related to socioscientific issues can be included in the curriculum.

3. Qualitative studies can be conducted by selecting the gender distribution of candidates in the science and social studies teaching departments closer to each other.

4. The sample of this study is only pre-service teachers. More detailed studies can be conducted with teachers and students at different levels, in which quantitative and qualitative data collection tools are used together.

5. In order to increase the awareness of teachers, students, and teacher candidates about socioscientific issues in related departments, project studies and seminars with the content of activity development can be organized.

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