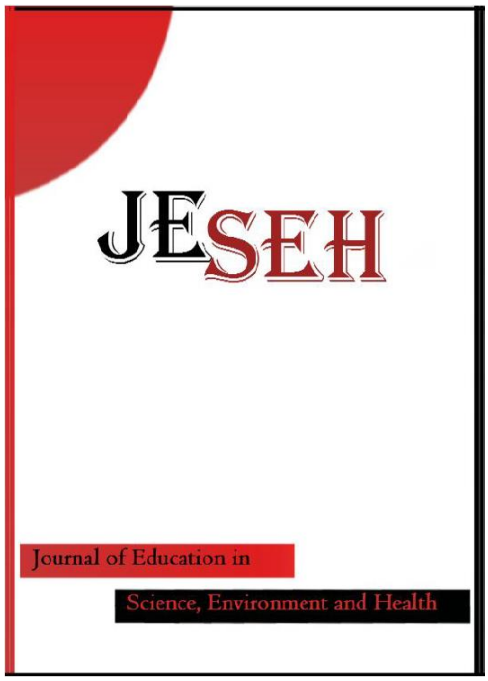

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Promoting Preservice Teachers' Attitudes toward Socioscientific Issues

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Abstract

In this study, we aimed to improve preservice teachers' attitudes toward socioscientific issues through socioscientific issue course. Moreover, we investigated whether this course influences preservice teachers studying in a science education and non-science education in a similar way. For this purpose, a semester-long socioscientific issues course was designed and implemented. Data were collected from a science education group (preservice science teachers) and a non-science education group (preservice social-science teachers). In order to evaluate participants' attitudes towards socioscientific issues, Attitudes towards Socioscientific Issues Scale was utilized before and after the course. This scale evaluates attitudes under three themes: liking of socioscientific issues, interest and usefulness of socioscientific issues, and anxiety towards socioscientific issues. The result revealed that socioscientific issues course provided similar gains for both preservice science teachers and preservice social-science teachers on interest and usefulness of socioscientific issues, liking of socioscientific issues, and anxiety towards socioscientific issues. That is both groups derived a similar benefit from the socioscientific issues course. Specifically, socioscientific issues course contributed to preservice teachers' interest and usefulness of socioscientific issues, and liking of socioscientific issues positively. On the other hand, their anxiety scores did not change significantly after the course. These findings imply that, regardless of majors, socioscientific issues course has potential to favor preservice teachers' attitudes toward socioscientific issues.

Introduction

"The world today is both an exciting and difficult place in which to live" (Massialas, Sprague, & Hurst, 1975, p.5). It raises many challenges for citizens. Energy crisis, consumer choices, health decisions, environmental concerns are some of them on which people have to take responsibility and make decisions. Deboer (2011) underscores that "As citizens of the world, there are science-based issues that affect us all, and understanding the science that underlies those issues is critical for effective global citizenship" (p. 568). These issues will be prominent in future regardless of citizens' readiness to deal with them (Sadler, 2004). These challenges are termed as socioscientific issues (SSI) because they have both social and scientific aspects as well as technology (Sadler, 2004). SSI are "complex, open-ended, often contentious dilemmas, with no definitive answers" (Sadler, 2004, p. 514). Specific examples of SSI include nuclear power plants, global warming, genetically modified food, abortion, stem cell, cloning, vaccination and experimenting on animals. Citizens learn about these issues through different mass media (e.g. news, the internet, and TV) and they often participate in public discourse to reach a decision about them. The research on socioscientific issues suggests that SSI has multiple perspectives including science, technology, economy, politics, religion, health which makes it debatable (Sadler, Barab, & Scott, 2007). The ability to discuss and make informed decisions about socioscientific issues are among the essential characteristics of science literacy. Science literacy has become a goal of science education worldwide with the aim of preparing people for rapid developments in science and technology. There is no consensus on the definition of science literacy (Roberts, 2007). Roberts synthesized the views for scientific literacy under two visions. The vision I of scientific literacy refers to an understanding of scientific concepts, principles, and processes within a determined science domain. Vision II, on the other hand, takes into account science-related issues which students face as citizens in everyday life. It gives importance to the knowledge and skills students should have to negotiate these issues and participate in decision-making process. A recent view of scientific literacy also supports Vision II. The Programme for International Student Assessment (PISA) is defined scientific literacy as "the ability to engage with science-related issues, and with the ideas of science, as a reflective citizen. A scientifically literate person is willing to engage in reasoned discourse about science and technology" (OECD, 2015, p. 20). Scientifically literate individuals are expected to analyze and evaluate data, claims, and arguments and reach appropriate scientific conclusions (OECD, 2015). These abilities are basics of high-quality socioscientific argumentation and socioscientific decision-making process.

SSI are suitable contexts to engage students in discussions of science-related social issues. These issues have been a part of school curricula since the negotiation of these issues are accepted as an essential characteristic of citizens in modern democratic societies. There is substantial effort to include SSI in lessons to improve science content knowledge, nature of science views, argumentation skills, or critical thinking skills. Scholarly papers emphasize the teaching of SSI as one of the goals of science education for educating scientifically literate citizens (Hofstein, Eilks, & Bybee, 2011; Lee, Chang, Choi, Kim, & Zeidler, 2012; Sadler, et al, 2007; Zeidler, Sadler, Simmons, & Howes, 2005). However, SSI has been implemented not only in science education but also in many different disciplines.

In this study, we focused on preservice science and social science teachers' attitudes toward SSI because these two disciplines represent the science and social aspects of SSI. Moreover, they are all citizens of the society and they all should be responsible members regardless of the major. As citizens, they need to know about local, national, and global SSI and have the necessary skills for negotiation and decision-making. For those reasons, their attitudes toward SSI become important. In a general sense, attitude is defined as "a general and enduring positive or negative feeling about some person, object, or issue" (Petty, & Cacioppo, 1996, p.7). Maio and Haddock (2009) underlined that attitudes "influence how we view the world, what we think, and what we do" (p. 4). Teachers' positive attitudes toward SSI play a crucial role in deciding whether they incorporate SSI into their lessons. Teachers' willingness to engage in science-related issues may increase their students' interest in SSI. Teachers' implementation of SSI-based practices in their classrooms requires engaging with SSI beforehand. Therefore, SSI-based practices should be a part of their training in teacher education programs. Preservice teachers' (PTs) negotiation of SSI is important to improve their personal decisions making skills that every PTs need to use at some stage in their both daily life as a citizen and professional life as a teacher (Cansiz & Cansiz, 2015). When PTs are equipped with knowledge and skills about SSI during their teacher training, they transform these knowledge and skills to their student when they start teaching. As a result, their students are also engaged in SSI and have necessary knowledge and skills to make informed decisions on these issues. In light of this, we designed a course on SSI to engage preservice science teachers (PSTs) and preservice social science teachers (PSSTs) in socioscientific argumentation and decision making.

Incorporating SSI in a classroom environment is an effective way of supporting the development of students to be more informed and to be engaged citizens, which is one of the fundamental goals of science education (Sadler, 2011). SSI instructions facilitate students' learning science by using complicated and socially relevant issues as contexts (Sadler, 2011). Previous research showed that using SSI in teaching is beneficial for students to learn science content knowledge; develop interest, attitude, and motivation; understand nature of science; and use higher order thinking skills such as informal reasoning, problem-solving, scientific reasoning, argumentation, and critical thinking (Sadler, 2009). Some studies compared the effect of implementations including SSI with traditional science teaching methods. For example, students who participated in an intervention considering Science Technology and Society based curricula developed more positive attitudes towards science than others (Lee & Erdogan, 2007; Yager, Lim, & Yager, 2006). In another study with university students, Barber (2001) concluded that SSI-related course has a positive influence on students' interest in science and evaluation of the science content they learned. Thus, in a general sense, it can be concluded that including SSI in the classroom teaching results in enhancement of students' positive affective outcomes (Sadler, 2009).

SSI was integrated into the elementary social science curriculum in 2005 (Ministry of National Education [MoNE], 2005) and in the elementary science curriculum in 2013 (MoNE, 2013) in Turkey. Developing habits of mind through the use of socioscientific issues has become a goal of science education (MoNE, 2013). For this purpose, SSI -such as the use of food additives- were integrated into the curricula for students to discuss and argue about it. Elementary social science curriculum aims to build student' understanding of the relation between science, technology and society. Moreover, it intends for students to be able to participate in discussions related to personal or societal problems and to present their ideas to solve them. Therefore, both science and social science teachers should be able to teach SSI and also use them as a context for teaching the course content. However, they may not have enough knowledge and confidence to teach SSI. There is a substantial body of research investigating preservice teachers' knowledge of SSI and concerns for teaching SSI. Based on a critical review of related literature in Turkish context (Topcu, Mugaloglu, & Guven, 2014), most of the studies reported that Turkish preservice teachers have low level of knowledge about SSI and have concerns about teaching these issues (e.g. Soysal, 2012; Sürmeli & Şahin, 2012) although few reported high level of knowledge about SSI (e.g. Sönmez & Kılınç, 2012). In a study with 169 Turkish PSTs, Cebesoy and Dömez-Şahin (2013) asked participants to rate their level of knowledge about SSI. Most of the participants reported that they have a low level of knowledge (%53.8) and some even reported to have no knowledge at all (%5.0).

Similarly, Cansiz and Cansiz (2015) investigated preservice science teachers' views and knowledge about a specific SSI, nuclear power plant, which has recently been a hot topic on the agenda of Turkey. The results indicated that PSTs were knowledgeable about some aspects of nuclear energy yet they know little about some other aspects. For instance, while PSTs are aware of the economic burden of removing nuclear power plants, they know little about the amount of radiation emitted by nuclear power plants. Another line of research indicated that Turkish preservice teachers do not feel confident in teaching SSI as well (e.g. Alaçam–Akşit, 2011; Kara, 2012). The abovementioned studies point out that PTs' knowledge and concerns about SSI have an important role in teaching SSI. Therefore, their knowledge and confidence should be improved to prepare them to teach SSI in their future classroom.

Fostering PTs' positive attitudes toward SSI may help them to increase their knowledge about SSI as well as to reduce their concerns about teaching SSI. Having positive attitudes towards SSI means having interest to these issues, reading and discussing them, and being aware of that SSI does not adversely influence society (Topcu, 2010). People who like SSI and are interested in SSI are more likely to criticize and justify their decisions about SSI by using scientific reasoning, decision-making, and argumentation skills. Despite the educational researchers' growing interest in teaching and learning SSI, studies about attitude toward SSI are limited. One of these few studies was conducted by Topcu (2010): he developed and validated Attitudes towards Socioscientific Issues Scale, in the Turkish context. In the same study, Topcu compared science education majors and non-science education majors' attitudes towards SSI and found that science education majors have more positive attitudes toward SSI than non-science education majors. In another study, Cebesoy and Dönmez-Şahin (2013) examined PTs' attitudes in terms of gender and grade level. The authors found that there is no difference between PTs' attitudes toward SSI with respect to gender and grade level. These studies addressed PTs' existing attitudes toward SSI. However, there is a need for studies focusing on how to improve PTs attitudes towards SSI. Since it takes a long period of time to develop attitudes, PTs' positive attitudes toward SSI should be improved, before they become a teacher, to achieve the goals of the curricula. Promoting PTs' attitudes is possible through the courses which mainly focus on the SSI (Sadler, 2009). Thus, we aimed to design an SSI course in which students were engaged in role plays and argumentation on different SSI to present their ideas and refute others' who advocate a different point of view. We expect to enhance preservice teachers' interest, and liking of SSI and decrease their concerns about SSI by this course. Thus, the overarching research question and corresponding sub-questions guided this study are:

I. Do PSTs and PSSTs benefit from the SSI course similarly in terms of attitude toward SSI?
    i. How does SSI course affect PSTs' attitudes toward SSI?
    ii. How does SSI course affect PSSTs' attitudes toward SSI?

Method

In this study, we used "try something and systematically observe what happens" approach as emphasized by Fraenkel and Wallen (2006, p. 268). This is also known as establishing cause and effect relationship between independent and dependent variables. To do this, we manipulated the independent variable (SSI course) to observe the extent to which our dependent variable (attitudes towards SSI) is affected by it. Manipulating independent variables makes this study an experimental study which is a type of quantitative research methodology (Fraenkel & Wallen, 2006).

Sample

We analyzed a total of conveniently-available 86 preservice teachers' data. Among them, 54 were preservice science teachers and 32 were preservice social-science teachers. Although females far outnumber males among preservice science teachers (70% vs. 30%), the number of males exceed the number of females among preservice social-science teachers (39% females and 61% males). In terms of their average result of all grades achieved in teacher education program, PST (GPA = 2.51) and PSST (GPA = 2.68) were comparable to each other. The students' average age in both groups were similar and ranging from 19 to 28 with a mean of 22.28 (SD = 1.55). It was ensured that none of the participants in both groups had taken a course focusing on SSI before.

Instrument

Attitudes towards Socioscientific Issues Scale (ATSIS), developed by Topcu (2010), is a five-point Likert type scale and its response format is ranging from (1) strongly disagree to (5) strongly agree. In the development process of the scale, the author conducted exploratory factor analysis (EFA) as well as confirmatory factor analysis (CFA) with the data from two different samples of undergraduate students. The ultimate result of EFA yielded three factors named as liking of SSI (7 items), interest and usefulness of SSI (17 items), and anxiety toward SSI (6 items) with a total of 30 items. The cross-validation of ATSIS using CFA provided evidence that three-factor structure of the scale has a good model fit to the data. These factors, their description and sample item for each were given in Table 1.

Table 1. ATSIS factors, their description and sample item (Adapted from Topcu, 2010)

ATSIS Dimension	Description of the Dimension	Sample Item
Liking of SSI	The extent to which students have feeling of enjoyment of SSI or like SSI	"I like conducting research on SSI."
Interest and usefulness of SSI	The extent to which SSI arouse students' interest and the application of SSI is found useful among students	"Since SSI is related to daily life, I would like to learn more details about SSI."
Anxiety toward SSI	The extent to which students have concern and worries about SSI	"I think that social values suffer from the implementation of SSI."

In addition to EFA and CFA, Topcu (2010) administered reliability analysis to screen the internal consistency of the scale for each sub-dimension. He found Cronbach alpha coefficients of .90 for interest and usefulness of SSI, .81 for the liking of SSI and .70 for the anxiety towards SSI, suggesting high internal consistency of the data. Backed up by literature from attitude studies, based on related reliability and validity evidence, it was concluded that ATSIS is an appropriate instrument to measure undergraduate students' attitudes towards SSI.

In order to compare participants' pre-existing and post-implementation attitudes, we have used ATSIS before and after the implementation. Internal consistencies for each dimension related to pre-implementation were, based on Cronbach alphas, .77 for the liking of SSI, .85 for interest and usefulness of SSI, and .72 for anxiety towards SSI which satisfy the criterion of acceptability. Cronbach alphas obtained from post-implementation were found to be .85, .92, and .71 for the liking of SSI, interest and usefulness of SSI, and anxiety towards SSI, respectively. In other words, all dimensions of ATSIS were found to be reliable with our sample.

SSI Course Framework

For the purpose of the study, we designed a semester-long SSI course to promote PSTs' and PSSTs' attitudes towards SSI. Since PSTs and PSSTs were studying at different universities, they were taught by two different professors who have similar educational backgrounds. In order to ensure the similarity of implementations in both groups, each week before the course, they skyped to discuss the details of the activities each week before the course,. They also skyped after the course and discussed the extent to which they reach previously set goals. These after-course discussions indicated that they had similar activities to a great extent. The course lasted for 14 weeks and 2 class-hour for each week. At the beginning of the course, we assessed both group students' pre-existing attitudes using ATSIS. The completion of the classroom activities took 22 classroom-hour (11 weeks of the total time). The implementation was divided into two parts: teacher-guided classroom activities and student-directed classroom activities. Teacher guided activities did not include exemplary case of teaching SSI, instead they were about theoretical ideas about SSI. The details of these activities were discussed below. Right after the completion of the instruction, we measured participants' post-implementation attitudes by using ATSIS once more to be able to compare their pre-existing and post-implementation attitudes. And finally, we conducted required statistical analysis to find out the possible effect of the instruction on attitudes towards SSI. Table 2 summarizes the main points of the SSI course.

Table 2. Outline of the SSI course

Timing	Application	Classroom activities
Week 1	First Meeting	Introductions of course objectives, content, resources and process
Week 2	Pretests	Administration of Attitudes towards Socioscientific Issues Scale
Week 3-8	Teacher-guided classroom activities	Classroom discussions guided by instructor on different topic (Epistemology of science, science literacy, nations, what is SSI and etc.)
Week 9-13	Student-directed classroom activities	SSI related classroom activity organized and acted by preservice teachers
Week 14	Posttest	Administration of Attitudes towards Socioscientific Issues Scale

Teacher-guided Classroom Activities

In teacher-guided classroom activities, PTs engaged in a variety of activities under the guidance of the instructors. First of all, they discussed what science is and the life of some of the most influential scientists such as Leonardo da Vinci. The aim here was to develop PTs' understanding about the complex epistemology of science. Following that we let PTs focus on scientific and technological literacy and the status of Turkey regarding scientific and technological literacy. Then, instructors guided PTs to argue about science and technology in developed, developing, and underdeveloped countries, as well as the situation in Turkey. The teacher-guided classroom activities continued with science, technology, and society and the complex relationship between them. In the context of this topic, PTs watched a documentary film about how science, technology, and society influence each other and they reflected on it. More specifically the documentary focuses on how the modern world evolves under the influence of geographical factors as well as technological developments. Moreover, it includes how the wars among the nations have led and accelerated technological developments and how scientifically developed nations better take care of epidemic diseases than underdeveloped nations. Following week, students were introduced SSI for the first time. The classroom discussions were based on what SSI is, historical fundamentals of SSI, SSI elements in the curriculum, and teaching of SSI. We completed teacher-guided classroom activities by letting students to discuss if science is naturally good or bad. That is, when science is used in the good sense, it can be for people's benefit, but it can also be one of the greatest enemy of mankind when used in the wrong direction. For example, nuclear technology can be used in cancer treatment as well as nuclear bomb at the same time.

During teacher-guided classroom activities, the aim was not to provide PTs with teacher-centered instruction. On the contrary, instructors made every effort to avoid it and acted as a guide to make PTs explicitly and reflectively discuss each and every activity. Both instructors encouraged them to introduce their own ideas, defense it, listen to others' ideas, elaborate them, and challenge with counter-claims. While PTs were working on the activities, instructors followed them that they were active during discussions. In brief, during the first half of the instruction, discussion and argumentation methods were utilized mainly and students actively participated in teacher-guided classroom activities.

Student-Directed Classroom Activities

Student-directed classroom activities lasted for five weeks. Each week two groups completed their activities which were mostly based on role-playing and argumentation. By means of these activities, we anticipated achieving more than one objectives. Firstly, we aimed to stimulate PTs' imagination and creativity by role playing activities. Secondly, we engaged them in argumentation and decision-making process. Moreover, we expect them to develop social skills such as communication, being empathetic, and cooperative during problem-solving by group work. Above all, we aimed to improve their socioscientific reasoning skills such as looking at the same problem from multiple perspectives, understanding the importance of scientific information, and building arguments and counter arguments in the negotiation of socioscientific issues.

Before role-playing activities, each group chose a specific socioscientific issue that has a direct or indirect effect on both society and science. We suggested them to handle issues primarily from the city they were born, the city they live in, or at least from Turkey to facilitate their job in finding plenty of materials and first-hand evidence. In the context of this activity, students studied as a group of four to five. Members of the group acted their roles in front of the other class members and the instructor. Each group member behaved like a different stakeholder of the specific issue under investigation such as a politician, an authorized person in religious affairs, a scientist,

a physician, or a local person. By providing concrete evidence to support themselves, group members presented their positions on the issue adhering to their role. Moreover, each PT struggled to refute others' arguments by using diverse evidence. During the end of the activity, a whole-class discussion took place by the question-and-answer method. In the end, each group aimed at reaching a possible solution of that SSI by evaluating each stakeholders' positions and evidence. Some of the example SSI were abortion, the death penalty, sperm banks, and euthanasia. A complete list of SSI was tabulated in Table 3. The selected SSI was quite similar in both groups as seen in Table 3.

Table 3. The list of SSI role played in both groups (sorted by application order)

Timing	SSI in Science Group	SSI in Social Science Group
Week 9	Carrier maternity Abortion	Organ transplant Abortion
Week 10	Mother's milk banks Nuclear power plants	Nuclear power plants Death penalty
Week 11	Genetically modified foods Cloning	Face transplant surgery Use of animals in experiments
Week 12	Euthanasia Alternative medicine	Captive breeding Global warming
Week 13	Organ Transplant Global warming	Sperm banks Euthanasia

In order to avoid PTs to engage in shallow discussion solely based on their intuitive assumptions and anecdotal evidence during role play, they were required to prepare a report containing concrete evidence like statistics reports, government documents, articles, and documentary notes before the activity. To create a deeper sense of reality, preservice teachers were encouraged to dress similar to whom they were acting during role play as well.

Results

The main objective of this study was to develop PTs' favorable attitudes toward socioscientific issues through socioscientific issue course. After a semester-long SSI course, we tested statistically if the course has an effect on preservice teachers' attitudes toward SSI as well as if this impact differs for PSTs and PSSTs by using mixed between-within subjects ANOVA. Further evaluation of assumptions showed that the data did not include any univariate or multivariate outliers, any serious deviation from normality, and unequal distribution of variance. The examination of descriptive data indicated that PSTs and PSSTs have similar scores on all three subscales of ATSIS (i.e. interest and usefulness of SSI, liking of SSI, anxiety toward SSI). For example, PSTs' anxiety toward SSI (M = 2.27, SD = .61) and PSSTs' anxiety toward SSI (M = 2.23, SD = .65) were quite similar before the course and they both indicated a low level of anxiety toward SSI. Other descriptive statistics are given in Table 4.

Table 4. Descriptive statistics related to PSTs' and PSSTs' ATSIS scores

	PST		PSST	
	Pretest Mean (SD)	Posttest Mean (SD)	Pretest Mean (SD)	Posttest Mean (SD)
Liking of SSI	3.74 (.50)	4.06 (.55)	3.89 (.61)	4.19 (.46)
Interest & usefulness of SSI	4.12 (.33)	4.31 (.42)	4.32 (.37)	4.43 (.40)
Anxiety towards SSI	2.27 (.61)	2.30 (.63)	2.23 (.65)	2.26 (.61)

Liking of SSI

Regarding liking of SSI, the result of mixed between-within subjects ANOVA indicated that the interaction between group and time was not statistically significant, Wilks Lambda = 1.00, F (1, 84) = .01, p = .926, partial eta squared < .001. That is, the influence of SSI course on the liking of SSI is independent of the major. The interpretation of main effect for time demonstrated that SSI course resulted in significant increase in liking of SSI (Wilks Lambda = .72, F (1, 84) = 32.37, p < .001, partial eta squared = .28). For in depth evaluation of both groups' liking of SSI scores, post-hoc comparisons were utilized. In order to reduce inflated Type I error

resulting from multiple comparisons, Bonferroni adjustment was applied. PSTs' scores on liking of SSI significantly increased from pre-implementation to post implementation, F (1, 84) = 22.47, p < .001, partial eta squared = .21. Similarly, there was a statistically significant increase in PSSTs' scores on liking of SSI, F (1, 84) = 12.47, p = .001, partial eta squared = .13. Namely, both groups showed a significant increase in their liking of SSI scores after SSI course.

Interest & Usefulness of SSI

In terms of interest and usefulness of SSI, -as evident from the non-significant interaction effect- the course resulted in similar changes for both PSTs and PSSTs, Wilks Lambda = .99, F (1, 84) = .95, p = .334, partial eta squared = .01. This means that the impact of the course on interest and usefulness of SSI does not differ in terms of the majors. The main effect for time signified that SSI course yielded a significant increase in interest and usefulness of SSI (Wilks Lambda = .85, F (1, 84) = 14.32, p < .001, partial eta squared = .15) in both groups. Bonferroni-adjusted post-hoc comparison illustrated that PST' interest and usefulness of SSI scores significantly increased after SSI course, F (1, 84) = 15.21, p < .001, partial eta squared = .15. Although PSSTs' interest and usefulness of SSI scores increased after SSI course (mean difference = .11, CI: -0.01 to 0.23), this increase did not reach statistical significance, F (1, 84) = 3.15, p = .080, partial eta squared = .04.

Anxiety towards SSI

In terms of anxiety towards SSI, the result of mixed between-within subjects ANOVA demonstrated that the interaction between group and time was not statistically significant. That is, SSI course yielded similar change for PSTs and PSSTs on anxiety towards SSI. (Wilks Lambda = 1.00, F (1, 84) = .00, p = .958, partial eta squared < .001). The main effect for time indicated that SSI course did not change participants' anxiety towards SSI scores significantly in either group (Wilks Lambda = 1.00, F (1, 84) = .12, p = .730, partial eta squared < .001). A summary of mixed between-within subjects ANOVAs are given at Table 5.

Table 5. Summary of mixed between-within subjects ANOVAs

Source	*df*	*F*	*Partial* η^2	*p*
Interaction Effect				
Liking of SSI	1	.01	.00	.926
Interest & usefulness of SSI	1	.95	.01	.334
Anxiety towards SSI	1	.00	.00	.000
Error df			84	
Within Subjects				
Liking of SSI	1	32.37	.28	.000
Interest & usefulness of SSI	1	14.32	.15	.000
Anxiety towards SSI	1	.12	.00	.000
Error df			84	
Between Subjects				
Liking of SSI	1	1.72	.02	.193
Interest & usefulness of SSI	1	4.60	.05	.035
Anxiety towards SSI	1	.11	.00	.737
Error df			84	

Discussion

In the present study, we aimed to enhance PTs' attitudes towards SSI. To achieve this, we designed a semester-long SSI course in which PTs participated in argumentation and role playing on a selected SSI after completing teacher guided classroom activities. We investigated the effect of SSI course on PTs' attitudes and examined whether this effect differs for PTs in science education and non-science education majors. Since SSI was included in elementary science and social science curriculum, both groups of teachers are expected to provide sufficient guidance to their students' while teaching SSI. Therefore, we selected PST as science education group and PSST as non-science education group to observe the changes in their attitudes towards SSI. Attitude towards SSI was examined under three dimensions, namely liking of SSI, interest and usefulness of SSI, and anxiety towards SSI. Preliminary analyses showed that, before taking the course, both groups have moderate levels of interest and liking of SSI while they have a low level of anxiety.

The first finding of this study showed that both groups of PTs similarly benefitted from the SSI course. After taking the SSI course, enhancements were observed in their liking of SSI, and interest and usefulness of SSI scores, while there was no change in both groups' anxiety towards SSI scores. To account for this improvement in their interest and liking of SSI, the nature of activities appears to be the primary reason. In designing SSI course, we followed the main strategies in a series of research studies that made use of different SSI. Argumentation, as one of them, is used widely in many studies to enhance individuals' skills on the development of arguments and justifications to discuss SSI (e.g. Dawson & Venville, 2013; Erduran, Simon, & Osborne, 2004; Patronis, Potari, & Spiliotopoulou, 1999).

Argumentation is mostly incorporated into decision-making activities in the literature. In Patronis et al.'s (1999) study, students formed arguments to make decisions about a road construction in their local area. A similar strategy was also used in the study conducted by Jime´nez-Aleixandre (2002) who let the students engage in argumentation and decision making process about an environmental issue. It is clear from these studies that argumentation and decision-making activities quite-well accompanied with socioscientific issues. Inspired by such examples from the literature, the SSI course in this study involved small group activities in which students formed arguments and try to reach a decision on the SSI they selected. Since Khishfe (2012) suggested that socioscientific issues that are more relevant to students have more potential to initiate interest, we asked them to select an SSI which were most relevant to them. On the other hand, while anxiety scores increased in some amount in both groups, the changes were not statistically significant. At the beginning, we expected that engaging in SSI through different classroom activities may reduce their anxiety toward SSI because they have become informed about several of SSI. However, as mentioned, this is not the result that we found. The reason for the slight increase in anxiety scores can be attributed to the nature of specific SSI. That is socioscientific issues such as abortion, sperm bank, mother's milk bank, euthanasia, and career maternity are topics that are very sensitive in terms of religion. Having thought the religious beliefs of Turkish citizens, it is rational that the anxiety scores did not reduce. However, this finding is not disappointing since they already had low levels of concern and worry about SSI before the course.

One key finding of this study is that preservice teachers' interests and liking of SSI increased in both groups after participating in SSI course. The goal of the course was to educate PTs' as informed citizens about SSI and to enhance their attitudes towards SSI. Moreover, we aimed to prepare them to argue and form opinions based on different aspects of socioscientific issues. Thus, within the course, they learned how to present arguments for and against the issue under discussion. Therefore, we can conclude that the discussions and the activities in the course were effective in fostering teacher candidates' interest and usefulness of SSI as well as liking of SSI. Another reason for this improvement may be due to the fact that they were not involved in student directed group activities without preparation. Before each group's discussion, group members searched for the SSI they have chosen. This let them have prior knowledge about the issue. To be knowledgeable about the issue increases students' interest in the issue and helps them form arguments (Khishfe, 2012; Mason & Scirica, 2006).

We know that SSI is important and has been included in many nation's curricula of different disciplines. Scholars accept that being able to negotiate and reach a possible solution on SSI are skills that scientifically literate citizens should have (e.g. Patronis et al., 1999). Therefore, obtaining similar findings for both science education and non-science education groups is promising for raising scientifically literate citizens. SSI course nearly equally improved these groups' attitudes towards SSI. Having a higher level of science background may not be a prerequisite to make investigations about SSI and discuss with others who had different points of views. Since both groups of participants were adults at undergraduate level, they are expected to have fundamental skills in searching and discussing the social aspects of scientific phenomena. Thus, regardless of the background science knowledge, both groups of PTs increased their interest and liking of SSI, and maintain their anxiety about SSI in low level. According to Topçu (2015), in order to teach SSI teachers should have sufficient subject matter knowledge, be aware of the social aspects of the SSI, and effectively guide and contribute students' learning process. With the help of the SSI course, PTs' interest and liking of SSI can be increased within the teacher education programs before they started to teach SSI in their classrooms. Although teachers are not expected to know everything about a specific SSI, they should know plenty of scientific concepts related to that SSI (Topçu, 2015). In this study, PTs had the chance of learning about a wide range of SSI and they were expected to deeply learn at least one of them during their discussions in the SSI course. Since we did not measure PTs' subject matter knowledge in the course of the study, we don't know whether this course increased their subject matter knowledge. However, they had the opportunity to observe and experience an SSI instruction in which they can take a model and implement similar activities during their inservice teaching to engage students in class discussions and to develop their critical thinking skills. In order to generalize these findings, replication of this study in different majors such as physics education, chemistry education, biology education, primary school education, and math education is needed. As the last word, based on our findings from different

majors, we can suggest that including SSI course in teacher education program will be beneficial to enhance different major PTs' interest and liking of SSI and this, in turn, will help them include SSI as a context in their future classrooms. For this purpose, SSI course can be a part of teacher education programs to make PTs gain more experiences to discuss and learn about socially relevant issues (Topcu et al., 2014). A teacher is one of the most important factors among the school related variables to influence students' learning (Sanders, Wright, & Horn, 1997). Thus teachers' attitudes towards SSI seem important, as it is potential to influence their students' attitudes.

Implications and Limitations

This study has some implications for preservice teacher education. Firstly, teachers' attitudes towards SSI is important for their students to develop positive SSI attitudes. Therefore, while training preservice teachers, their attitudes should be developed through such courses.

This study showed that science background is not a decisive factor for the effectiveness of SSI course on increasing attitude towards SSI. It may be because of the education level of the participants of this study. Since they are university students, they should have some fundamental science content knowledge. Therefore, it can be expressed that having fundamental science background might be sufficient to understand the science lying behind the SSI, conduct research about SSI, to analyze the findings, and to participate in class discussions to defense an idea about SSI against others. Therefore, teacher educators should utilize similar activities while teaching complex and multidimensional science topics. Moreover, this course can be offered for other teacher education programs and disciplines. This is promising for increasing the number of scientifically literate people.

Lastly, we have some suggestions for future research. First, this study provided empirical evidence that SSI course can increase PTs' interest of SSI and liking of SSI. However, further research is needed to figure out how long this effect will last. Second, longitudinal studies are needed to explore how PTs' attitudes towards SSI will influence their students in their future classrooms. Lastly, the effect of such SSI courses on younger students (middle or high school students) may also be investigated to make sound inferences about the effect of such courses in earlier years.

Although this study has successfully demonstrated that the SSI course has improved PTs' attitudes towards SSI, it has limitations as well. It is unfortunate that this study did not include a comparison group, we could not compare the effectiveness of the classroom activities used in the SSI course with a different approach to teach SSI. Moreover, as we did not have control groups, more evidence is needed to conclude that the SSI course accounted for the increase in PTs' attitudes towards SSI. Lastly, the instrument used in this study (ATSIS) does not focus on a specific SSI, instead, it considers SSI in general. Therefore, it is not possible to explore participants' attitudes on a unique SSI. Their attitudes may change in some degree for specific SSI. We hope that taking into account these limitations, in future, studies will carry SSI studies one step further.

Note

All authors have equally contributed to this paper.

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