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The effect of using web 2.0 tools in the teaching of socio-scientific issues on pre-service science teachers

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Abstract

The purpose of the current study is to investigate the effect of using Web 2.0 tools in the teaching of socio-scientific issues on pre-service science teachers. A total of 24 senior pre-service science teachers attending a state university in the spring term of the 2021-2022 academic year participated in the study. The study was conducted with the participation of pre-service science teachers taking the course of Teaching Practice II, using different Web 2.0 tools on 6 different socio-scientific issues. The study employed the mixed method. In the quantitative dimension of the study, the "Web 2.0 Rapid Content Development Self-Efficacy Belief Scale" and the "Scale of Attitudes towards Socio-scientific Issues" were used as data collection tools. In the qualitative dimension of the study, interviews were conducted with the pre-service science teachers using a semi-structured interview form in order to get the opinions of the pre-service science teachers on the Web 2.0 tools-assisted teaching of socio-scientific issues. The quantitative data were analysed using the SPSS 20.00 program package while the qualitative data were analyzed by using the content analysis method. According to the results of the study, no statistically significant difference was observed between the pre-test and post-test mean attitude scores of the pre-service science teachers. However, a statistically significant difference was observed between the pre-test and post-test mean scores taken from the "Web 2.0 Rapid Content Development Self-Efficacy Belief Scale". When the qualitative findings of the study were evaluated, it was seen that the pre-service teachers were of the opinion that the use of socio-scientific issues in science lessons most improved their skill of solving problems in daily life. When the pre-service teachers were asked the techniques they preferred in the teaching of socio-scientific issues, the discussion technique came to the fore. Pre-service teachers think that socio-scientific issues should be taught as a required or elective course in undergraduate education. Among the discussion topics addressed in the project process, "Genetically Modified Organisms (GMOs)" was the subject that most attracted the attention of the pre-service teachers. When asked about the positive and negative aspects of Web 2.0 tools in science education, the pre-service teachers stated effective and permanent learning as the positive aspect and technological inadequacies as the negative aspect. Permanent learning came to the fore again when the pre-service teachers were asked about the contributions of the use of Web 2.0 tools in the teaching of socio-scientific issues to the educational process. The pre-service teachers found Scrumlr.io and Edmodo applications among the Web 2.0 tools much more useful in the teaching of socio-scientific issues. In addition, the pre-service teachers stated that they would make use of Web 2.0 tools in socio-scientific issue-based teaching in their professional lives in the future.

Keywords: Web 2.0 tools, socio-scientific issues, science teaching, pre-service science teachers.

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1. Introduction

1.1. Socioscientific issues

Changes and innovations in science and technology in today's world have led to the emergence of social dilemmas (Topçu, Muğaloğlu, & Güven, 2014; Yapıcıoğlu & Kaptan, 2017) and the emergence of various discussion topics with many moral and ethical dimensions (Akbaş & Çetin, 2018). Socio-scientific issues are defined as controversial social issues that have a scientific basis, are of interest to the society, are open-ended, and on which no definite decision has been reached (Sadler, 2004; Sadler and Zeidler, 2005). In order for a subject to be a socio-scientific issue, it must have a scientific basis and be a social problem that concerns society (Eastwood, Sadler, Zeidler, Lewis, Amiri and Applebaum, 2012). Issues such as the use of additives in food, local environmental problems, nuclear power plants, global warming, genetically modified organisms, genetic tests, gene therapy, stem cells, cloning, vaccines, genetic engineering applications and industrial activities can be given as examples to socio-scientific issues (Goloğlu, 2009; Nuangchalerm & Kwuanthong, 2010; Patronis, Potari, Spiliotopoulou, 1999; Zengin, Keçeci, Kırılmazkaya & Şener, 2012; Zohar & Nemet, 2002). The use of socio-scientific issues in science education is one of the most effective ways to improve students' science literacy (Sadler et al., 2004; Zeidller et al., 2019). When Sadler and Zeidler (2009) examined the relationship between science literacy and socio-scientific issues, they concluded that in order to create meaningful learning environments for students, it is necessary to use real-life science-related topics as a tool, and this will increase the excitement and desire of students to learn.

In our country, socio-scientific issues were directly emphasized for the first time under the STSE (Science-Technology-Society-Environment) learning area in the science curriculum updated in 2013 (Topçu et al., 2014). Among the main objectives of the 2013 Science Curriculum, the importance of socio-scientific issues is expressed as "to develop scientific thinking habits by using socio-scientific issues" and in the 2018 science curriculum as "to develop reasoning, scientific thinking habits and decision-making skills using socio-scientific issues" (MEB, 2013; 2018). When it comes to the use of socio-scientific issues in educational environments, it is seen that there are some benefits to students. The use of socio-scientific issue-based instruction provides students with the opportunity to rebuild their prior knowledge and reconstruct their conceptual understanding of socio-scientific issues through social discourses and personal experiences (Sadler and Zeidler, 2005).

As in every change in education, teachers have a very important role in the effective integration of socio-scientific issues into the classroom (Lee, Abd-El-Khalick & Choi, 2006). For this reason, besides the existing studies (Presley et al., 2013; Sadler, 2004) explaining the elements to be considered in the planning of socio-scientific issue-based teaching, teachers should be supported to have the ability to implement and plan socio-scientific issue-based teaching (Genel and Topçu, 2016). The teacher should position

himself/herself as a contributor to discussion rather than an authority, and be able to act as catalyst, facilitator, and mentor in interactions without revealing his or her position on the socio-scientific issues students are working on (Zeidler and Kahn, 2014). Science teachers should constantly follow the agenda for issues that directly affect the society, keep their knowledge fresh, be aware of new scientific developments, be able to specialize in their field and guide their students to make the right decisions about science (Bacanak, 2002).

1.2. Web 2.0 Tools

As a result of the developments in information technologies, different Web tools have been developed and offered for use so that individuals can access the data they need and interact with the data (Akkoyunlu & Kurbanoğlu, 2003; Castells, 2011; Mazurczyk, Wendzel, Zander, Houmansadr & Szczypiorski, 2016). In the process of developing technologies and the integration of these technologies into education, Web 2.0 tools have come to the fore. Today, the effects of Web 2.0 technologies can be easily seen in almost all areas of life.

Web 2.0 is an idea that started as a brainstorming in a conference session and was first used by Tim O'Reilly in 2004 (O'Reilly, 2005). Internet technologies of today's world, also referred to as Web 2.0 applications, offer advantages such as easy communication, fast information sharing and easy access to necessary data, active data design, information recording, measurement and evaluation, visualization and access at a level that can be easily reached by participants of all ages (Altun, 2008). The most basic feature of Web 2.0 is the easiness of the use of tools and the spontaneous occurrence of collaboration and social interaction (Atıcı and Yıldırım, 2010). In order to be able to use these rapidly developing and increasingly becoming widespread technologies in human life, 21st century students and teachers must have skills such as "digital competence" and "digital literacy". In this connection, Web 2.0 technology should be seen as a technological move that supports changes and developments in education and should be included more in educational environments (Elmas & Geban, 2012).

Arslan (2009) states that in the information sharing environment provided by Web technology, students will have the opportunity to evaluate both their own work and the work of other students and see the strengths and weaknesses of their own work, thus they can increase their self-awareness. The advantages of Web 2.0 tools such as providing easier and faster access to information when needed, hosting digital content, reducing costs, enabling users to control access to resources by verifying their identity, and focusing on information innovation rather than technology alone (Grosseck, 2009) can be capitalized on in education. Web 2.0 tools not only make learning fun for students who grow up between school desks and technological tools, but also enable permanent learning, improve peer teaching and provide equal opportunity (Mete & Batıbay, 2019). It is observed that when web technologies are successfully integrated into the classroom, students' skills to participate in the lesson, communicate, produce information, publish,

share, learn collaboratively and provide feedback can be improved (Crook, 2012; Ferdig, 2007; Rosen & Nelson, 2008; Serrat & Rubio, 2012). In addition, it provides students with learning environments suitable for learning by doing and experiencing and contributes to the development of their ability to actively use their research, questioning and problem-solving skills and thus to develop these skills (Özmen, Aküzüm, Sünkür and Baysal, 2011). In addition, researchers emphasize that Web 2.0 tools are very effective tools for structuring social interaction in constructivist learning environments (Bruns and Humphreys, 2005).

Teachers who are one of the most important elements of the education system are expected to have technological, pedagogical and content knowledge competences such as using information technologies to meet the educational needs of the 21st century, having a good command of their subject area, using teaching methods and techniques suitable for the characteristics of the subject and ensuring active participation (Altıok et al., 2017). It is a necessity for teachers to keep up with technology, be at peace with technology and be open to learning in terms of the active use of Web 2.0 tools. Teachers need to have the ability to integrate the functions of Web 2.0 tools into their education processes, to use them, and most importantly, to integrate them into their own subject areas. Moreover, according to Horzum (2010), teachers should be supported and provided with the required training, so that they can use the Internet and Web 2.0 tools in their teaching. In this context, in the current study, it was aimed to raise awareness of pre-service science teachers about the use of Web 2.0 tools in the teaching of socio-scientific issues. In-class discussions involving the use of different web 2.0 tools on 6 different socio-scientific issues were conducted with the pre-service teachers for 6 weeks. The effects of the study on the pre-service science teachers' attitudes towards socio-scientific issues and Web 2.0 rapid content development self-efficacy beliefs were examined through the scales applied before and after the study. In addition, the pre-service teachers' opinions about the use of Web 2.0 tools in the classroom environment and about socio-scientific issues were elicited. The study is important as it includes applications on which web 2.0 tools can be used by pre-service science teachers to integrate socio-scientific issues into the classroom environment and it can enable pre-service teachers to create a collaborative and interactive learning environment rather than adopting a traditional teaching approach in their future professional life. The purpose of the study is to investigate the effect of using Web 2.0 tools in the teaching of socio-scientific issues on pre-service science teachers. To this end, answers to the following questions are sought in the study?

1. Does the use of Web 2.0 tools in the teaching of socio-scientific issues have an effect on the pre-service teachers' attitudes towards socio-scientific issues?

2. Does the use of Web 2.0 tools in the teaching of socio-scientific issues have an effect on the pre-service teachers' Web 2.0 rapid content development self-efficacy beliefs?

3. What are the opinions of the pre-service teachers about the use of Web 2.0 tools in the teaching of socio-scientific issues?

2. Method

2.1. Research Design

The current study is a mixed method research in which quantitative and qualitative data collection tools are used together. According to Creswell (2003), mixed method research refers to a researcher's combining qualitative and quantitative methods, approaches and concepts within a single study or successive studies.

2.2. Study Group

The study group of the current research is comprised of 24 (22 female, 2 male) senior pre-service science teachers attending the Faculty of Education of a state university in the spring term of the 2021-2022 academic year. The pre-service science teachers participating in the study were taking the course of Teaching Practice II. The reason why the study group was chosen in this way is that the participants would be easily reachable by the researcher and the researcher would be able to conduct applications within the context of the course of Teaching Practice II.

2.3. Ethics committee permission

The study was carried out within the scope of the TÜBİTAK project and ethics committee approval was obtained for the study.

2.4. Data Collection:

Quantitative and qualitative data collection tools were used in the study.

2.4.1. Quantitative data collection tools

In the study, the "Web 2.0 Rapid Content Development Self-Efficacy Belief Scale" and the "Scale of Attitudes towards Socio-scientific Issues" were used as quantitative data collection tools.

2.4.2. Web 2.0 Rapid Content Development Self-Efficacy Belief Scale: The scale was developed by Birişçi, Kul, Aksu, Akaslan and Çelik (2017). Each item in the 21-item scale can be responded on a five-point Likert scale of "Never, Rarely, Sometimes, Often, Always" and scored from 1 to 5 in the same order. The scale was administered to 337 pre-service teachers studying in different departments of Education Faculties and exploratory and confirmatory factor analyses were conducted on the collected data. As a result of the exploratory factor analysis, 21 items gathered under 3 factors were found to explain 65.63 % of the total variance. These factors are grouped as the usability of Web 2.0 tools in the process of preparing the course content, presenting the course content and evaluating the learning outcomes. The Cronbach-Alpha internal consistency coefficient of the scale, whose final form was given after the factor analysis, was found to be $\alpha = 0.955$.

2.4.3. Scale of Attitudes towards Socio-scientific Issues: The scale was developed by Topçu (2010). The scale consists of 30 five-point Likert type items responded with one of the following response options; "1-Strongly disagree", "2-Disagree", "3-Undecided", "4-Agree", "5-Strongly agree". As a result of the exploratory and confirmatory factor analyses, it was revealed that the Cronbach alpha internal reliability coefficients of the scale ranged between .70 and .90 and that the scale consisted of 3 sub-dimensions. The Cronbach alpha internal reliability coefficients for the sub-dimensions were calculated and found to be .81 for the sub-dimension of "Enjoying socio-scientific issues", .90 for the sub-dimension of "The benefit and importance of socio-scientific issues" and .70 for the sub-dimension of "Anxiety about socio-scientific issues".

2.4.4. Qualitative data collection tools

Before the study, a semi-structured interview form consisted of 15 questions was prepared. The prepared interview questions were sent to 2 faculty members who are experts in the field of science education, and they were finalized in line with their feedbacks. Afterwards, it was confirmed whether the questions were comprehensible or not by interviewing a pre-service teacher. It was determined that the questions were comprehensible and after a few necessary corrections were made, interviews were conducted with the pre-service teachers and each interview lasted for about 25 minutes. The interviews were recorded and it was stated that the recordings of the interviews would be kept confidential within the framework of ethical rules.

2.5.Application of the Study:

Before the study, the "Web 2.0 Rapid Content Development Self-Efficacy Belief Scale" and the "Scale of Attitudes towards Socio-scientific Issues" were administered as pre-tests. In the weeks after the application of the scales, the applications were carried out as follows:

2.5.1. 1st Application Week

The subject of "Nuclear Power Plants" was studied in the first application week. First, the *mentimeter* Web 2.0 tool was used to find out what concepts are evoked in the minds of the pre-service teachers when nuclear power plants are mentioned. Afterwards, a video about the structure and working principle of nuclear power plants was shown to the pre-service teachers and on the basis of the case of the Mersin/Akkuyu Nuclear Power Plant prepared with the *canva* program, the pre-service teachers were asked if they were to take on the role of one of 6 different individuals and organizations, including the scientist, nature activists, government officials, local people's association, workers of a local cancer foundation and representatives of local people, which one would they prefer? Why? Finally, the opinions of the pre-service teachers on the positive and negative aspects of nuclear power plants were obtained via *scrumlr.io*, then the pre-service

teachers were asked the question "Do you think nuclear power plants should be established or not? Why?" and their opinions were listed via *scrumlr.io* and the reasons for their opinions were asked to each pre-service teacher. The pre-service teachers were able to see each other's opinions on *scrumlr.io* and explained with their reasons whether they agreed with each other or not. Those with different opinions tried to refute the arguments of others.

2.5.2. 2nd Application Week

In the second week, the subject of "COVID-19 and the effectiveness of vaccines" was studied. A presentation was made about vaccines. Then, with the *scrumlr.io* Web 2.0 tool, the opinions of the pre-service teachers were obtained by making them choose one of the given options and complete the sentence; I did not get vaccinated / I was vaccinated willingly / I was forced to get vaccinated because ..... Afterwards, a video containing 5 different vaccine features was watched on youtube and a visual giving information about the effectiveness of vaccines was shown to the pre-service teachers. Again, through the *scrumlr.io* web 2.0 tool, the pre-service teachers were presented with the following options; I got Biontech / Sinovac / both of them, and they were asked to explain why they preferred this vaccine and on what grounds they preferred it. By demonstrating the features of the *canva* web 2.0 tool in an applied manner, posters consisting of their own slogans about masks and vaccines were prepared with the pre-service teachers.

2.5.3. 3rd Application Week

In the third week, the subject of "Space Research" was studied. The pre-service teachers were asked the question "Do you think a budget should/should not be allocated to space research?" and they were asked to answer the question via the *google form*. A presentation was made by using the *padlet* web 2.0 tool about space research, products that entered our lives as a result of space research, negative and positive aspects of space research. Two different videos, including the positive and negative aspects of space research, were watched and then the pre-service teachers were asked to choose one of the following options and complete the sentence on *scrumlr.io;* space research should be done because ...../space research should not be done because ..... The pre-service teachers having different opinions expressed their opinions on the basis of their arguments.

2.5.4. 4th Application Week

In the fourth week, the subject of "Genetic Tests" was studied. A presentation was made on *canva* about what genetic tests are and who can have these tests. A concept map prepared with the *edrawmax* Web 2.0 tool used to show where genetic tests are used was shown. The pre-service teachers were asked what the advantages and disadvantages of genetic testing are and these questions were answered interactively by sharing links over the *mentimeter* Web 2.0 tool. After discussing the advantages and disadvantages, videos containing various news were watched. Finally, a scenario having a dilemma prepared

with the *storyboardthat* Web 2.0 tool was used. The pre-service teachers were asked to choose one of the causes given in the scenario and to choose one of the following options and complete the sentence; Yes because …. / No because …. / Undecided because …….

2.5.5. 5th Application Week

In the fifth week, the subject "Organ Donation" was studied. First, a video about organ donation was watched on YouTube. Afterwards, a presentation prepared about organ donation in the form of a digital story was made on the *storyjumper*. In this presentation, information was given about what organ donation is, which organs can be donated, the necessary conditions for organ donation, etc. Then, the puzzle prepared with the help of the *crosswordlabs* Web 2.0 tool was filled together with the pre-service teachers. By showing two different news stories about the positive and negative aspects of organ donation, the pre-service teachers' opinions were elicited through such questions as "what are the positive aspects of organ donation/what are the negative aspects of organ donation/do you consider donating your organ?" via the *scrumlr.io* web 2.0 tool.

2.5.6. 6th Application Week

In the sixth week, the subject of "Genetically Modified Organisms (GMOs)" was studied. The pre-service teachers were asked the question "What concepts come to your mind when you hear the term GMO?" and a mind map was created with the *ayoa* web 2.0 tool. Afterwards, the pre-service teachers were informed about GMOs with a poster prepared on *glogster* and after the presentation, the blanks in the worksheet prepared via *wizer.me* were filled. They were asked to comment on the news that was previously sent to the class via *edmodo*. Videos about the positive and negative aspects of GMO were watched. Then, the pre-service teachers wrote their thoughts on the positive and negative aspects of GMOs over the *mentimeter* Web 2.0 tool. Positive and negative aspects were also mentioned in the poster prepared on the *thinglink* Web 2.0 tool. With the *renderforest* Web 2.0 tool, the Genetic Improvement scenario was shown to the pre-service teachers in the form of an animation video and their opinions were taken.

After the completion of the applications, the "Web 2.0 Rapid Content Development Self-Efficacy Belief Scale" and the "Scale of Attitudes towards Socio-scientific Issues" were administered to the participants as post-tests. After the administration of the scales, semi-structured interviews were conducted with the pre-service teachers and the study was concluded.

2.6. Data Analysis:

In the analysis of the quantitative data, SPSS 20.00 program package was used. While data analysis is performed with parametric tests in tests with normally distributed data, non-parametric test analyses can be performed on tests whose data do not show a normal distribution. At the same time, due to the small number of the study group, the distribution of statistics across the sample cannot approach the normal distribution and in this case, non-parametric tests can be used (Karagöz, 2010, p.19).

In the current study, Shapiro-Wilk and Wilcoxon Signed Rank Tests were used in the analysis of the data. All the data obtained through the scales were analyzed using the SPSS 20 program package. In the study, first, Shapiro-Wilk test was performed to see whether the data were normally distributed, and it was observed that the data were not normally distributed. In addition, non-parametric Wilcoxon Signed Rank Test was used because the size of the study group was smaller than 30. In the Wilcoxon Signed Ranks test, which is the non-parametric equivalent of the two dependent samples t-test, the variances do not need to show equality and a normal distribution (Baştürk, 2010).

The qualitative data were analyzed by using the content analysis method. At the end of the interview, audio recordings were transcribed and content analysis was made by two researchers separately. By comparing the analyses made by the two researchers, it was seen that the reliability was over 90% according to the formula proposed by Miles & Huberman (1994) and differences discussed until a consensual coding was agreed. The data were interpreted in tables with the support of sample quotations. Within the framework of ethical rules, the names of the pre-service teachers were coded as P1, P2, P3,…...

3. Results

The findings obtained from the current study are presented under the headings of quantitative and qualitative data.

3.1. Findings obtained from the quantitative data

3.1.1. Pre-test and post-test results related to the attitudes of the pre-service science teachers towards socio-scientific ıssues

The findings derived from the results of the Wilcoxon Signed Rank Test conducted to determine whether there is a significant difference between the pre-test and post-test attitude scores of the pre-service science teachers are presented in Table 3.1.1.

Table 3.1.1. Results of the wilcoxon signed rank test conducted to determine whether there is a significant difference between the pre-test and post-test attitude scores of the pre-service science teachers

Dimensions	Pre-test-Post-test	N	Mean Rank	Sum of Ranks	Z	P
Benefit and importance	Negative rank	8	11.31	90.50	-1.446	.148
	Positive rank	15	12.37	185.50		
	Equal	1				
Enjoying	Negative rank	6	12.08	72.50	-1.498	.134
	Positive rank	15	10.57	158.50		
	Equal	3				
Anxiety	Negative rank	13	12.69	165.00	-.824	.410
	Positive rank	10	11.10	111.00		
	Equal	1				
Total	Negative rank	11	9.64	106.00	-.974	.330
	Positive rank	12	14.17	170.00		
	Equal	1				

When the results of the analysis shown in Table 3.1.1. are examined, it is seen that there is no statistically significant difference between the pre-test and post-test total scores of the pre-service science teachers in terms of their attitudes towards socio-scientific issues (z=-.974>; p=.330>.05). When the results of the analysis are examined in terms of the sub-dimensions, it is seen that there is no statistically difference between the pre-test and post-test scores taken from the sub-dimension of benefit and importance (z=-1.446; p=.148>.05), the sub-dimension of enjoying (z=-1.498; p=.134>.05) and sub-dimension of anxiety (z. =-.824; p=.410>.05).

3.1.2. Pre-test and post-test results of the pre-service science teachers regarding their web 2.0 rapid content development self-efficacy beliefs

The findings derived from the results of the Wilcoxon Signed Rank Test conducted to determine whether there is a significant difference between the pre-test and post-test results of the pre-service science teachers' Web 2.0 rapid content development self-efficacy beliefs are presented in Table 3.1.2.

Table 3.1.2. Results of the wilcoxon signed rank test conducted to determine whether there is a significant difference between the pre-test and post-test scores of the pre-service science teachers' web 2.0 rapid content development self-efficacy beliefs

Dimensions	Pre-test-Post-test	N	Mean Rank	Sum of Ranks	Z	P
Presentation	Negative rank	2	5.00	10.50	-3.788	.000
	Positive rank	20	12.15	243.00		
	Equal	2				
Preparation	Negative rank	2	3.00	6.00	-4.117	.000
	Positive rank	22	13.36	294,00		
	Equal	0				
Evaluation	Negative rank	1	2.00	2.00	-4.142	.000
	Positive rank	22	12.45	274.00		
	Equal	1				
Total	Negative rank	2	1.50	3.00	-4.107	.000
	Positive rank	21	13.00	273.00		
	Equal	1				

When the results of the analysis shown in Table 3.1.2. are examined, it is seen that there is a statistically significant difference between the pre-test and post-test total scores regarding their Web 2.0 rapid content development self-efficacy beliefs in favour of the post-test (z=-4.107>; p=.000<.05). When the results of the analysis are examined in terms of the sub-dimensions, it is seen that there is a statistically significant difference between the pre-test and post-test scores taken from the sub-dimension of presentation (z=-3.788; p=.000<.05), the sub-dimension of preparation (z=-4.117; p=.000<.05) and the sub-dimension of evaluation (z=-4.142; p=.000<.05), in favour of the post-tests.

3.2. Findings obtained from the qualitative data

In this section, the findings obtained from the semi-structured interviews conducted with the pre-service teachers are presented under separate headings.

The pre-service teachers were asked, "*Have you encountered the concept of socio-scientific issue before? a. If your answer is "yes", how did you encounter it, through your lessons or through your own effort? If you encountered it through the lessons, what did you do in that lesson?"* and thus the information sources of the pre-service teachers about socio-scientific issues were determined. The obtained findings are presented in Table 3.2.1.

Table 3.2.1. Pre-service teachers' sources of information about socio-scientific issues

Codes	Participants	
Yes, I have.	P1,P2,P3, P22,P4,P5,P8,P9,P10,P20,P24 P11,P12,P14,P17,P18,P19,P21,P23	Through lessons
	P16,P7,P13	Both through lessons and social media
	P6	Through social media
No, I haven't.	P15	

When the answers are analyzed, it is seen that the pre-service teachers mostly encountered the concept of socio-scientific issue in their undergraduate lessons they took (Science Teaching I). Apart from this, 1 pre-service teacher stated that he/she encountered the concept through social media, and 3 pre-service teachers stated that they encountered both through lessons and social media. One pre-service teacher stated that he/she had never encountered the concept before and heard it for the first time in the project. Pre-service teachers expressed their opinions as follows:

"I encountered through lessons. We had discussions about different socio-scientific issues in the lesson" (P22)

"I had encountered the concept of socio-scientific issue before in lessons. First, we were asked to do a research, so that we could have information about the subject, then we discussed the subject with our other friends in the classroom environment. Then, we wrote something on the subject. It was about Covid 19 and GMOs lasting for two class hours." (P4)

"I encountered it in the science pages I followed on social media and in the magazines I read." (P6)

The pre-service teachers were asked ***"****What do you think about the use of socio-scientific issues in science lessons? What could be the benefits for students?"* The findings obtained from the answers of the pre-service teachers are presented in Table 3.2.2.

Table 3.2.2. Benefits of using socio-scientific issues in science lessons to students

Codes	Participants
Solving problems in daily life	P3,P4,P6,P21,P22,P24
Questioning	P1,P5,P14,P16, P21
Multi-dimensional thinking	P1,P12,P7,P11,P18
Encouraging to do research	P4,P5,P9,P16,P21
Respecting other ideas	P9,P10,P13
Establishing empathy	P9,P10,P17,P21
Meaningful and permanent learning	P2,P17,P20
Increasing interest in lesson	P4,P23
Increasing students' course attendance	P4,P15
Decision making	P5,P19
Training science literate individuals	P8
Allowing students to defend their own ideas	P21
Being aware of scientific issues	P4
Making students focus on lesson	P4
Arising interest in students	P4
Drawing students' interest	P15

When the answers of the pre-service teachers were examined, it was seen that the benefit of using socio-scientific issues in the science lesson most mentioned by the pre-service teachers is the development of their ability to solve problems in daily life. Some of the answers given by the pre-service teachers to this question are as follows:

"*I think it should be used actively in science lessons. I think that it will arouse curiosity in students and will increase their interest in the lesson so that they can find solutions to the problems of daily life by researching socio-scientific issues, they will be aware of other scientific subjects while doing research, they can examine the studies on the subjects, they can focus more on and participate in the lesson.*"(P4)

"I think it will draw the interest of students, so that the students will participate more in the lesson."(P15)

"It motivates students to use what they have learned in science lessons in daily life. More meaningful connections can be established between science lessons and real life. Students learn to defend their ideas. They are motivated to research and question. If something happens in his/her close environment, he/she knows how to deal with it."(P21)

The pre-service teachers were asked "*If you were conducting socio-scientific issue-based teaching, which teaching methods and techniques would you prefer the most? a. What are the reasons for these preferences you have stated?"* and the obtained findings are presented in Table 3.2.3.

Table 3.2.3. Methods and techniques preferred in the teaching of socio-scientific issues

Codes	Participants
Discussion	P1,P8,P10,P11,P16,P18,P22
Brainstorming	P6,P7,P20,P21,P23,P24
Six-hat thinking	P6,P11,P13,P14,P21
Debate	P1,P7,P12,P14,P20
Question-answer	P7,P11,P16,P20
Cooperative learning	P2,P3,P15,P17
Cornering	P9,P10
Opposite panel	P14,P19
Opinion development	P13
Aquarium technique	P10
Circle technique	P4
Concept map	P5
Speaking ring	P20

When the pre-service teachers' answers were examined, it was seen that the most preferred technique is the discussion technique, followed by the six-hat thinking, dispute and brainstorming techniques. The least preferred techniques were found to be cornering, opposite panel, opinion development, aquarium technique, speaking ring, circle technique and concept map. Some of the answers given by the pre-service teachers are given below:

"*I would use the opposite panel technique because the existence of open-ended questions that create dilemmas with no clear answer will lead to students' questioning and coming up with one negative and one positive answer, so that two different ideas should be defended."(P19)*

"I would prefer to use the cornering technique, aquarium technique, discussion technique. With these techniques, students are actively involved and they can express their opinions more easily."(P10)

"I would mostly use techniques such as brainstorming and six-hat thinking because I would develop different perspectives and make everyone look at things from different perspectives individually." (P6)

The pre-service teachers were asked *"What do you think (a) the difficulties of the socio-scientific issue-based teaching? b. Conveniences of the socio-scientific issue-based teaching?*" The findings obtained from the analysis of the data are presented in Table 3.2.4.

Table 3.2.4. Difficulties and conveniences of the socio-scientific issue-based teaching

	Codes	Participants
DIFFICULTIES	High probability of disputes in class	P5,P11,P18,P21,P24
	Long time required	P2,P12,P20,P21,P24
	Lack of student attention	P6,P10,P14,P22
	Lack of teacher knowledge on the subject	P9,P8,P17,P18
	Lack of student knowledge on the subject	P8,P17,P18
	Crowded classrooms	P7,P13,P20
	Absence of a certain answer	P5,P16,P19
	Lack of teacher objectivity	P1
	Changing deeply-rooted beliefs	P23
	Ensuring student participation	P4
CONVENIENCES	Making sense of and interpreting events in daily life	P3,P11,P16,P17,P22
	Increasing the retention of subjects	P2,P3,P8,P14
	Fostering multidimensional thinking	P13,P18,P23,P24
	Developing critical thinking skill	P6,P7,P19,
	Generation of new ideas	P1,P4,P10
	Awareness of socio-scientific issues	P15,P24
	Offering a different learning environment	P12,P5
	Promoting research and inquiry	P20,P21
	Developing the decision-making skill	P18
	Facilitating the teaching of socio-scientific issues	P9

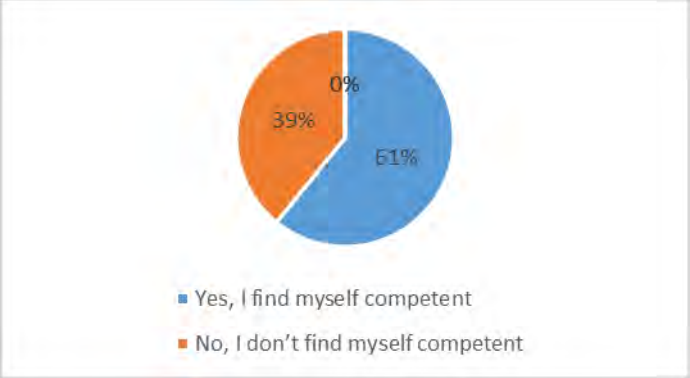
The answers given by the pre-service teachers were examined and the most frequently mentioned difficulties of the socio-scientific issue-based teaching were found to be the high probability of disputes in the class and long time taken by this type of teaching. On the other hand, the most frequently mentioned convenience of the socio-scientific issue-based teaching is making sense of and interpreting events in daily life. The pre-service

teachers coded as P3 and P15 stated that there are no difficulties in socio-scientific issue-based teaching. Some of the opinions expressed by pre-service teachers are given below:

"It can be difficult to draw students' attention to a social issue and make them understand it and to keep their attention on a topic for a long time. It becomes easier for students to make sense of and interpret events in daily life."(P22)

"It can be difficult to get students to discuss without hurting each other in a classroom setting. It can be a very diverse and colourful learning environment, with each student expressing his/her opinion."(P5)

The pre-service teachers were asked *"Do you consider yourself competent to be able to conduct socio-scientific issue-based teaching in your own classroom in your future teaching profession? a. If your answer is "yes", why do you think so? b. If your answer is "no", why do you think so?"* and the obtained findings are presented in Graph 1.



Graph 1. Pre-service teachers' perceived level of competence in conducting socio-scientific issue-based teaching

As can be seen in Graph 1, while 14 pre-service teachers consider themselves competent in the conduct of socio-scientific issue-based teaching in their future teaching career, 9 pre-service teachers do not consider themselves competent in this regard. One pre-service teacher is undecided. Some opinions expressed by pre-service teachers in this regard are given below:

"Yes, when I become a teacher in the future, I discuss these issues with my students. A lot of socio-scientific discussions that we had during this period were also effective in my thinking like this."(P14)

"No, I find myself incompetent as I encountered it for the first time. I need to improve myself more."(P15)

"My answer is yes, because in the education we received, we learned how to manage classroom discussions about socio-scientific issues. Thus, even though the students do not have a good grasp of the subject, I think that I can provide a discussion environment by using resources such as videos and scenarios to inform the students about the positive and negative aspects of the subject and by adding Web 2.0 tools to the process."(P18)

The pre-service teachers were asked "*What do you think are the characteristics that science teachers should have in order to bring socio-scientific issues to their classrooms?*" and the obtained findings are presented in Table 3.2.5.

Table 3.2.5. Characteristics that should be possessed by science teachers to teach socioscientific issues

Codes	Participants
Enough knowledge about the subject	P1,P7,P8,P10,P12,P15,P18,P20,P21
Objectivity	P7,P9,P10,P16,P17,P18,P24
Good management of the discussion process	P9,P10,P16,P17,P18,P20,P24
Questioning	P3,P8,P14,P19,P23
Technological competence	P2,P4,P5,P12,P15
Following innovations	P2,P5,P6,P12,P23
Respecting different opinions	P11,P13,P15,P18
Inquisitive	P3,P4,P21,P23
Having multiple perspectives	P5,P6,P14
Strong critical thinking skill	P7,P19,P22
Being open to innovations	P11

As can be seen in Table 3.2.5. , the most important characteristic to be possessed by science teachers to be able to teach socio-scientific issues according to the pre-service teacher is having enough knowledge about the subject, followed by being objective and managing the discussion process well. The characteristics of having multiple perspectives and strong critical thinking skill were emphasized by the same number of pre-service teachers. The characteristic least preferred was found to be being open to innovations. Some of the answers given by pre-service teachers are given below:

"He/She should be a science teacher who is objective, has strong critical thinking skills, and has done his/her research well. (P7)"

"They need to use technological tools well. I think they especially need to know Web 2.0 tools. They should be understanding teachers who can follow innovations and are open to different opinions."(P5)

"Science teachers should be objective and not let their own opinions dominate. Before the discussion, some rules should be determined in the classroom and it should be emphasized that students listen to each other and show respect."(P17)

The pre-service teachers were asked "*How do you think undergraduate education should be in order to increase the competence of pre-service teachers on socio-scientific issues?"* and the obtained findings are presented in Table 3.2.6.

Table 3.2.6. What should be done in undergraduate education to increase pre-service teachers' competence in socio-scientific issues

Codes	Participants
There should a required or elective course specific to socio-scientific issues	P1,P2,P3,P5,P6,P12,P13,P15,P17,P20
-They should be brought to class through in-class discussions	P4,P7,P9,P10,P11,P14,P18,P19,P20
-Greater importance should be attached to socio-scientific issues	P21,P22,P23,P24
-Students' interest should be drawn to socio-scientific issues	P8
Undergraduate education is already adequate	P16

As can be seen in Table 3.2.6. , the pre-service teachers are of the opinion that the most important thing to be done to increase pre-service teachers' competence in socio-scientific issues is offering a required or elective course specially designed for socio-scientific issues and brining socio-scientific issues to class through in-class discussions. Some of the answers given by pre-service teachers are shown below:

"It is necessary to allocate more place to socio-scientific issues in undergraduate education. Students may be asked to prepare discussion environments and they may be asked to do things like animation and drama. I think it can be offered even as a separate course." (P20)

"We had many classes that included socio-scientific issues. We presented, learned and discussed many issues. These are sufficient for undergraduate students. Pre-service teachers should improve themselves."(P16)

"Especially in undergraduate education, a separate course should be opened for these subjects and applications should be made through which we can learn the argumentation process."(P18)

The pre-service teachers were asked *"Which discussion or debates attracted your attention the most in the socio-scientific issue debates held every week? Why?"* and thus the socio-scientific issues that the pre-service teachers found most interesting were elicited. The obtained findings are presented in Table 3.2.7.

Table 3.2.7. The most interesting socio-scientific issues and discussions

Codes	Participants
GMO	P2,P3,P4,P5,P7,P8,P9,P11,P14,P21,P22
Organ donation	P4,P7,P8,P12,P14,P16,P19,P21,P22,P23
Space research	P4,P6,P9,P10,P11,P12,P13,P17
Genetic tests	P15,P16,P18,P23,P24
Nuclear power plants	P7,P10,P16
All the issues	P1,P20
COVİD 19 and effectiveness of vaccines	P14

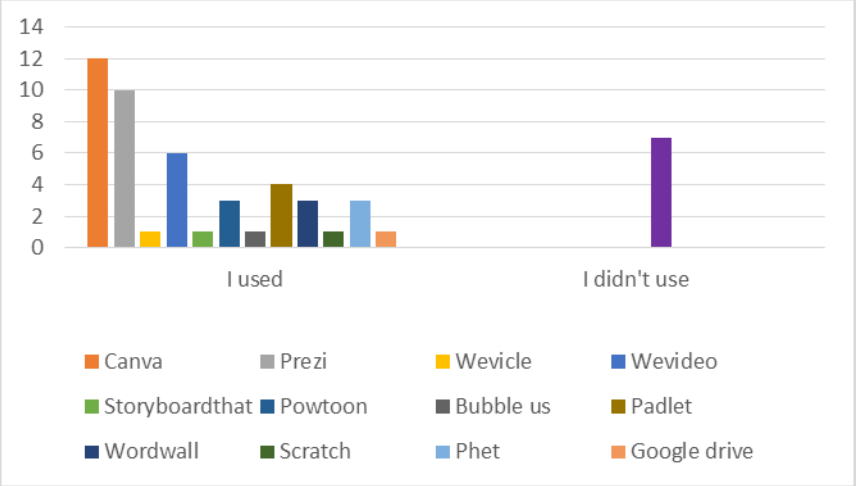
As can be seen in Table 3.2.7. , the discussions found to be most interesting by the pre-service teachers were on the issues of "Organ donation and GMO". The least interesting issue was found to be "COVİD 19 and effectiveness of vaccines". Two pre-service teachers stated that all the issues were interesting. Some of the answers given by pre-service teachers are given below:

"The discussion topic of genetic tests was interesting for me. The news watched and similar situations in my close circles and my friends increased my interest in the subject. While evaluating the situation of a family in the scenario about empathy, it left me in a dilemma between reasoning and emotions. I was very impressed with the situation and decision-making process of a mother."(P18)

"GMO and space research. I have always been interested in the subject of GMOs and I had a previous study on this subject in a different course. I find space research interesting."(P11)

On the second page of the interview form, questions about Web 2.0 tools were asked to the pre-service teachers. Findings derived from the answers are presented under separate headings.

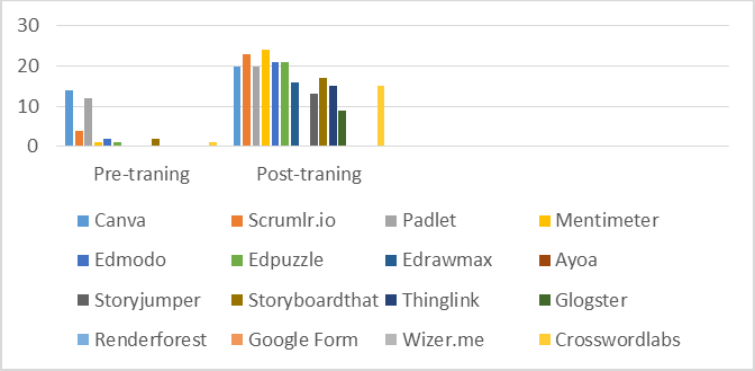
In order to determine which Web 2.0 tools the pre-service teachers used before the study, the pre-service teachers were asked *"Did you use Web 2.0 tools in your undergraduate courses before this study? If so, which one(s) did you use and how?"* Findings obtained from the answers are presented in Graph 2.



Graph 2. Web 2.0 tools previously used by the pre-service teachers

The pre-service teachers used the Canva application the most in their previous undergraduate courses, followed by Prezi and Wevideo. Seven pre-service teachers stated that they had not used any web 2.0 tool before.

In order to see which web 2.0 tools the pre-service teachers were able to learn and apply at the end of the project, they were asked "*Which of the Web 2.0 tools did you learn after the training?"* The answers given by the pre-service teachers regarding the pre-training and post-training web 2.0 tools are shown in Graph 3.



Graph 3. Web 2.0 tools preferred by the pre-service teachers before and after the training

When the answers of the pre-service teachers regarding the Web 2.0 tools known before the training are examined, it is seen that Padlet and Canva applications come to the fore. Web 2.0 tools such as Edrawmax, Glogster, Storyjumper, Ayoa, Google Form , Renderforest, Thinglink and Wizer.me are unknown to the pre-service teachers before the training.

When the answers given by the pre-service teachers are examined, it is seen that the most preferred Web 2.0 tool among the Web 2.0 tools learned after the training is the Mentimeter Web 2.0 tool. The Scrumlr.io Web 2.0 tool is the second most preferred Web 2.0 tool after Mentimeter.

In order to learn the opinions of the pre-service teachers about the positive and negative aspects of using Web 2.0 tools in science education, they were asked "*What effects can the use of Web 2.0 tools in science teaching have on the educational environment? What are the positive and negative aspects?"* Findings obtained from the answers are presented in Table 3.2.8.

Table 3.2.8. Positive and negative aspects of web 2.0 tools in science education

Codes		Participants
POSITIVE	Effective and permanent learning	P2,P4,P8,P9,P16,P18,P20,P21,P23,P24
	Increasing student interest in lesson	P1,P7,P8,P10,P12,P14,P21
	Making students active	P5,P8,P18,P20
	Drawing students' attention	P4,P7,P15,P18
	Learning by having fun	P2,P11,P17
	Imparting 21st skills	P19,P22
	Cheap and easy to use	P3
	Increasing in-class interaction	P6
	Time efficient	P13
NEGATIVE	Technological inadequacies	P3,P5,P6,P8,P9,P10,P14,P18,P13
	Crowded classrooms	P17, P13, P21,P24
	Time problem	P2,P7,P11
	Some applications are not free	P2,P22,P18
	Lack of teacher competence	P1
	Distracted student attention	P11
	Reluctance in students	P20

As can be seen in Table 3.2.8., the positive aspect of Web 2.0 tools most strongly emphasized by the pre-service teachers is their contribution to effective and permanent learning while the negative aspect most strongly emphasized is technological inadequacies. On the other hand, 6 pre-service teachers (P4, P12, P15, P16, P19, P23) stated that Web 2.0 tools do not have any negative aspects. Some of the answers given by pre-service teachers are given below:

"They increase interaction too much. When I look at the negative aspects, we do not know whether everyone has technological devices (phones, tablets, etc.) because they are highly technology-dependent."(P6)

"Web 2.0 tools make students more active in the process and increase retention as they are more interesting. They have negative effects because of technological inadequacies and because some applications are not free."(P18)

The pre-service teachers were asked *"What do you think is the contribution of teaching socio-scientific issues using Web 2.0 tools to the education process?"* and the findings derived from the answers are presented in Table 3.2.9.

Table 3.2.9. Contribution of teaching socio-scientific issues by web 2.0 tools to the education process

Codes	Participants
Permanent learning	P5,P9,P11,P16,P21,P23,P24,P20
Drawing student attention	P10,P13,P15,P16,P21,P24,P9
A free discussion environment	P1,P2, P7,P14,P20,P21
Developing a sense of curiosity in students	P2,P4,P21
Facilitating learning	P15,P21,P22
Increasing academic achievement	P8,P13
Creating an interactive and active learning environment	P18,P24
Saving time	P3
Developing positive attitudes towards socio-scientific issues	P6
Creating a different learning environment	P12
Developing the decision-making skill	P17
Enabling re-access to information	P18
Creating arguments	P19

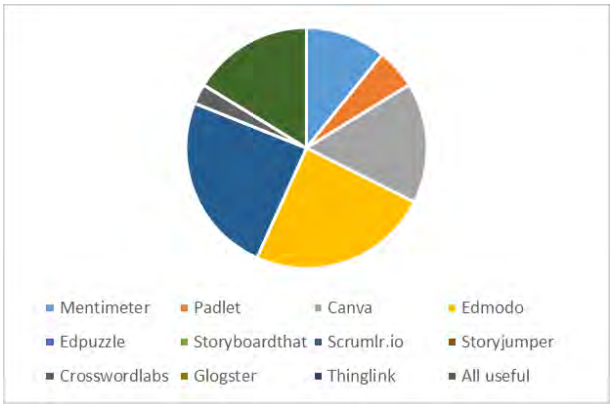
As can be seen in Table 3.2.9., the pre-service teachers are of the opinion that the greatest contribution of the use of Web 2.0 tools in the teaching of socio-scientific issues to the education process is more permanent learning. The contributions least emphasized by the pre-service teachers include saving time, developing positive attitudes towards socio-scientific issues, creating a different learning environment, developing the decision-making skill, enabling re-access to information and creating arguments.

"It can increase academic success by making the delivery of lessons or subjects more enjoyable."(P8)

"Socio-scientific issues require reasoning. They create a free discussion environment. They arouse students' curiosity."(P2)

"They increase retention and interest."(P16)

In order to determine which of the Web 2.0 tools that the pre-service teachers used during the process they found more useful, they were asked "*Which of the Web 2.0 tools used in the teaching of socio-scientific issues in the process did you find more useful? Can you explain with the reasons?"* The findings obtained from the answers of the pre-service teachers are presented in Graph 4.



Graph 4. Web 2.0 tools found to be useful by the pre-service teachers

As can be seen in Graph 4, six of the pre-service teachers think that all the Web 2.0 tools are useful. Some of the answers given by pre-service teachers are shown below:

"I really liked Canva. Canva is a graphic design platform that allows users to create presentations, posters and other visual content. It can be used on web and mobile and integrates millions of images, fonts, templates."(P19)

"I would use Mentimeter because I can get answers from many students at the same time. Likewise, students can express themselves more easily because their names are not written."(P7)

"I actually find them all useful because they all make it possible for us to do different things. That's why I couldn't choose. All have positive effects."(P6)

The pre-service teachers were asked "*Do you consider using web 2.0 tools while teaching socio-scientific issues in your lessons? Why*?" Findings obtained from their answers are presented in Graph 5.

Graph 5. Level of using web 2.0 tools when teaching socio-scientific issues

As can be seen in Graph 5, all of the pre-service teachers stated that they would use Web 2.0 tools in their lessons as they make the learning environment fun, facilitate the teaching and make learning more effective etc.. Some of the answers of pre-service teachers are given below:

"I would use because they worked well during the project. I would use them with my students because they could draw their attention. They would facilitate their learning. They might like conducting discussions via Web 2.0 tools. I think that the generation we will teach will be intertwined with technology; thus, will understand this more easily."(P21)

"Yes, even though it was not a socio-scientific issue, I saw that the digital story had a positive effect on the class while I was teaching in my teaching practice class in the 1st semester. Likewise, it will be more effective to present socio-scientific issues in these environments." (P2)

"Yes, I would use because, instead of teaching these subjects through lecturing in the classroom environment, presenting them in a visual, auditory and interactive way makes learning more permanent and teaching more active."(P5)

4.Discussion, Results and Suggestions

The purpose of the current study was to raise awareness among the senior pre-service science teachers on how to use different Web 2.0 tools in the teaching of socio-scientific issues, how to guide their students as teachers with these Web 2.0 tools, and how to support classroom interaction. In this context, lessons were conducted with the pre-service teachers on 6 different socio-scientific issues for six weeks using different Web 2.0 tools. As Web 2.0 tools, mentimeter, scrumlr.io, canva, padlet, google form, edrawmax, edpuzzle, storyboardthat, edmodo, storyjumper, crosswordlabs, thinglink, wizer.me, renderforest, ayoa and glogster were used. In the quantitative dimension of the study, the "Web 2.0 Rapid Content Development Self-Efficacy Belief Scale" and the "Scale of Attitudes towards Socio-scientific Issues" were used and semi-structured interviews were conducted with the pre-service teachers in the qualitative dimension of the study. According to the quantitative findings of the study, there is no statistically significant difference between the pre-test and post-test total scores of the pre-service science teachers' attitudes towards socio-scientific issues. However, a statistically significant difference was observed between the pre-test and post-test total scores for Web 2.0 rapid content development self-efficacy beliefs of the pre-service teachers in favour of the post-test scores. There are various studies in the literature that present findings similar to the quantitative findings of the current study. In the study conducted by Onbaşılı (2020), the effect of science teaching practices supported by Web 2.0 tools on the self-efficacy perceptions of the pre-service primary teachers was examined. In the current study, the Web 2.0 Rapid Content Development Self-Efficacy Scale was administered as pre-test and post-test, and a significant difference was found between the pre-test and post-test scores. Timur, Yılmaz, and Küçük (2021) aimed to measure the effect of Web 2.0 rapid

content development on self-efficacy beliefs in a study conducted on senior pre-service science teachers. When the findings of their study were examined, a significant difference was observed between the pre-test and post-test scores. In the study conducted by Kul, Aksu, and Birişçi (2019), Web 2.0-based lessons were conducted with pre-service mathematics teachers. In the study, the effect of conducting Web 2.0-based lessons on the self-efficacy beliefs of pre-service teachers about Web 2.0 was examined. When the findings of the study were examined, a significant difference between the pre-test and post-test scores was observed. The findings of these studies in the literature and those of the current study are parallel and a statistically significant difference was found between the pre-test and post-test total scores for Web 2.0 rapid content development self-efficacy beliefs of the pre-service teachers in favour of the post-test in the current study.

According to the qualitative findings of the study, the majority of the pre-service teachers encountered the concept of socio-scientific issue in the course of Science Teaching I, and when asked about the benefits of using socio-scientific issues in science lessons, they stated that their most important contribution is to the development of the skill of solving problems in daily life. When the pre-service teachers were asked their preferred methods and techniques in the teaching of socio-scientific issues, the discussion technique came to the fore. While the pre-service teachers were asked about the difficulties of the socio-scientific issue-based teaching, they stated that it might take long time due to in-class discussions and when asked about the conveniences of the socio-scientific issue-based teaching, they put the greatest emphasis on making sense of and interpreting events in daily life. The pre-service teachers were asked about their level of competence in teaching socio-scientific issues through Web 2.0 tools after the socio-scientific issue-based training and it was found that most of the pre-service teachers consider themselves competent. Pre-service teachers think that socio-scientific issues should be taught as a required or elective course in undergraduate education. Among the discussion topics in the project process, the GMO issue was the one that most attracted the attention of the pre-service teachers. The pre-service teachers mostly used the Canva Web 2.0 tool in the undergraduate courses they took at the faculty. The pre-service teachers mostly preferred the Canva Web 2.0 tool before training. The Web 2.0 tool most preferred after the training is the Mentimeter Web 2.0 tool. When asked about the positive and negative aspects of Web 2.0 tools in science education, the pre-service teachers most strongly emphasized their making effective and permanent learning possible as a positive aspect and technological inadequacies as a negative aspect. Permanent learning is at the forefront among the contributions made by the use of Web 2.0 tools in the teaching of socio-scientific issues to the education process. Among the Web 2.0 tools that the pre-service teachers find useful in the teaching of socio-scientific issues, Scrumlr.io and Edmodo applications are among the most frequently mentioned tools. In addition, the pre-service teachers stated that they would benefit from Web 2.0 tools in the teaching of socio-scientific issues in their professional lives in the future. When the literature related to the qualitative findings of the current study is reviewed, it is seen that there are various studies reporting similar findings. Timur, Timur, Arcagök, and Öztürk (2020) mentioned the benefits and conveniences of using Web 2.0 tools for science teachers. In

the study, teachers mentioned that with the use of Web 2.0 tools in the education process, the teacher can spare more time for his/her students. In the current study, the pre-service teachers stated that the use of Web 2.0 tools in science education would save time. In this context, the findings of the two studies support each other. In the study conducted by Timur, Timur, Arcagök and Öztürk (2020), teachers pointed to the problems that might occur because of technical problems as the negative aspect of Web 2.0 applications. In the current study, some pre-service teachers also stated that there might be technical problems such as internet access problems in the use of Web 2.0 tools in science lessons. In this regard, the findings of the two studies are parallel to each other. In the study conducted by Gürbüzkol (2019) on science teachers, science teachers stated that brainstorming, case studies, debate and question-answer techniques should be used in the teaching of socio-scientific issues. When the findings of the current study are examined in this context, it is seen that the pre-service science teachers more prefer brainstorming, debate and question-answer techniques among the techniques to be used in the teaching of socio-scientific issues; thus, the findings of the two studies are parallel to each other. Moreover, in the study conducted by Gürbüzkol (2019), the participating science teachers stated that socio-scientific issues enable students to make decisions, make comments, empathize, defend their own opinions, develop their critical thinking skill, change opinions and solve problems. When the findings of the current study are examined, it is seen that the pre-service science teachers are of the opinion that socio-scientific issues can help students make decisions, empathize, solve problems in daily life and respect different ideas. The findings of these two studies are similar to each other. In the current study, the pre-service science teachers stated that socio-scientific issues can help students develop their many different skills such as multidimensional thinking, conducting research, questioning, increasing interest in the lesson and meaningful and permanent learning. In the study conducted on science teachers, Kılıç (2019) found that teachers obtain information about socio-scientific issues from the media (TV, newspapers), textbooks, scientific journals, the education they received at universities, their colleagues, their own professional experiences and the education platforms of the Ministry of Education (EBA, Morpa Campus). In the current study, the pre-service science teachers stated that they encountered the concept of socio-scientific issue through media and through the lessons they had taken at university. In the study conducted by Kılıç (2019), teachers expressed the characteristics that science teachers should have in order to teach socio-scientific issues as being inquisitive and following the developments in the field. In addition, it was determined that science teachers should be experts in their field, follow scientific developments and be curious, have professional competence and vision. In the current study, the pre-service science teachers defined the characteristics to be possessed by science teachers as being inquisitive, following scientific developments and being curious. There is a parallelism between the findings of the two studies in this context. In the study conducted by Kılıç (2019), science teachers stated that an applied elective course can be opened by universities to address the teaching, dimensions and evaluation of socio-scientific issues in undergraduate education in order to teach socio-scientific issues better at schools. In the current study, the pre-service science teachers also stated that a separate course should be opened for the

teaching of socio-scientific issues in undergraduate education, discussions should be made on the basis of socio-scientific issues brought to the classroom and more importance should be attached to socio-scientific issues. In this context, the findings of the studies are parallel. In the study conducted by Bünül (2019), pre-service teachers stated that the use of Web 2.0 applications in the classroom environment would increase the effectiveness of teaching activities and the quality of teaching and that they are easy to use. In the current study, the pre-service science teachers stated that the use of Web 2.0 tools in science education contributes to effective and permanent learning in the education process and that their use is easy. In addition, the pre-service teachers stated that they have benefits such as attracting the attention of students, increasing their interest in the lesson and making students active and learning fun. Türkmen, Pekmez & Sağlam (2017) conducted a study on pre-service science teachers and found that the six-hat technique is the most preferred technique from among the techniques that can be used in the teaching of socio-scientific issues by the pre-service teachers when they become teachers. In the current study, the pre-service teachers also stated that they would prefer the discussion, brainstorming and six-hat techniques. In the study conducted by Türkmen, Pekmez, and Sağlam (2017), pre-service teachers stated that they got their knowledge about socio-scientific issues at the faculty or through media. In the current study, the pre-service teachers also stated that they encountered the concept of socio-scientific issues in their undergraduate lessons. In the study conducted by Demir (2019) on science teachers, the teachers stated that they had not taken any course on socio-scientific issues during their undergraduate education. However, they stated that they saw socio-scientific issues in different courses. In the current study, the majority of the pre-service teachers encountered socio-scientific issues in the course of Science Teaching I they took in their undergraduate education. In the study of Demir (2019), science teachers were found to be of the opinion that in order to increase the competences of science teachers on socio-scientific issues, more practical training on socio-scientific issues should be offered, socio-scientific issues should be taught in a separate required course and more research and discussions should be included. In the current study, the pre-service teachers also stated that socio-scientific issues should be taught as a separate course in undergraduate education and discussions should be held by bringing socio-scientific issues to the classroom environment. Demir (2019) argues that in order for science teachers to teach socio-scientific issues well, they should be investigative, curious and sensitive, be able to use different methodologies, be able to teach effectively, be knowledgeable about socio-scientific issues, be science literate, follow current events and constantly improve themselves. In the current study, the pre-service teachers expressed the characteristics that science teachers should have for teaching socio-scientific issues as being inquisitive, following the innovations and having sufficient knowledge about the subject. In light of the findings of the current study, the following suggestions can be made:

- With the integration of Web 2.0 tools into the teaching of socio-scientific issues in their future professional careers, pre-service science teachers can create cooperative

and interactive learning environments by moving away from a traditional education approach.

- Required or elective courses related to socio-scientific issues and Web 2.0 tools can be incorporated into teacher training programs of education faculties so that pre-service teachers can use Web 2.0-assisted socio-scientific issue-based teaching effectively in their classrooms in the future.
- Socio-scientific issues can be brought to the classroom environment and pre-service science teachers can be encouraged to conduct research on and question these issues. Sample activities and applications can be made about which Web 2.0 tools can be used on which socio-scientific issues.
- In order for Web 2.0 tools to be used in the classroom, classroom environments can be turned into an environment where these tools can be used easily.
- Science teachers can take care not to reflect their own views and be objective during a discussion process where they conduct Web 2.0-assisted socio-scientific issue teaching and to prevent possible problems by determining class norms before the discussion.

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