Journal of Turkish Science Education, 2022, *19*(1), 17-36.
DOI no: 10.36681/tused.2022.107

Journal of Turkish Science Education
http://www.tused.org
© ISSN: 1304-6020

The Effect of Socioscientific Issues-Based Discussion Activities on the Attitudes of Primary School Teacher Candidates to the Life Science Teaching

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ABSTRACT
The study aims to determine the effect of socioscientific issues-based activities on the attitudes of primary school teacher candidates' about life science teaching. In this research, 78 primary school teacher candidates (52 females, 26 male) determined by criterion sampling method participated. Attitude Scale of Life Science Teaching was used as pre-and post-test. While the courses with the teacher candidates in the control group were given based on the curriculum determined by the Council of Higher Education (YÖK), the experimental group teacher candidates held socioscientific discussion activities for eight weeks. The difference between the pre-and post-test mean scores of the primary school teacher candidates in the experimental and control groups was analyzed using the dependent and independent groups t-tests. The effect size was calculated (eta squared (ή2)) according to the variances between the scores. As a result of the research, it was determined that the difference between the pre-test and post-test average scores of the primary school teacher candidates in the experimental and control groups on life science teaching attitudes was not statistically significant. However, a statistically significant difference was found between the experimental group mean scores of their attitudes about life science teaching before and after the socioscientific issues-based discussion activities. The effect size (ή2) of the difference between pre-test and post-test mean scores was calculated as moderate. Socioscientific issues-based teaching activities, which are mostly used in researches on science courses, were used by the researcher in terms of life science teaching in this study.

ARTICLE INFORMATION
Received:
27.03.2021
Accepted:
25.08.2021

KEYWORDS:
Socioscientific issues, life science teaching, primary school teacher candidates, the attitude towards the course.

Introduction

There are new developments every day in science and technology in order to meet the changing needs of society, but it is also difficult to follow this development process. One of the easiest methods of adaptation to the rapid development and change process is to transfer this knowledge to future generations during the education and training process. However, considering that the information changes and updates almost every day, it is not enough to transfer the ready information (Gürbüzkol & Bakırcı, 2020; Palavan & Başar, 2014). Sharing, questioning, discussing, and explanation of information is considered important in learning processes; students participate in active learning processes with different activities organized under the guidance of teachers. Especially in the 21st century, teacher-centered education has turned into student-centered education, and the position of student has changed into the person who adopts the way of reaching information, interprets, uses and produces information, not memorizing knowledge (Arıcı, 2016). To educate a student model that thinks, questions, criticizes and produces solutions to problems, teachers should also include different

methods in the process. Discussions that can be focused on socioscientific issues are among the activities that can be instrumental to achieve the mentioned goals.

Socioscientific issues are complex, socially relevant real-world problems, which do not only appear in science but also have ethical dimensions (Sadler et al., 2016). Although socioscientific issues have a scientific aspect in a way, they are issues that contain individual or social observations and require decisions (Kolsto, 2010). Socioscientific issues do not have a precise and clear answer. They can change over time and are socially related to society (Tosunoğlu & İrez, 2019). These issues involve two-sided effects and evaluations such as benefit/loss, advantage/disadvantage and positive/negative (Yapıcıoğlu, 2020). Considering these points, students are also involved in these topics based on their interests, as socioscientific issues are related to daily life (Stefanova et al., 2010). Thus, boring and scientific topics that students do not care about can become more interesting and pleasing (Dolan et al., 2009). Because its contradicting structure and the cases that require decision-making involve the student in the active learning process.

Using current events, which are the focus of socioscientific issues, in the learning environment makes the course interesting and makes it easier for students to learn by exemplifying the issue. These issues enable students to get information about the world they live in and help them understand the difference between facts and opinions (Topcubaşı & Kabapınar, 2019). In a socioscientific issue-based teaching approach, socioscientific issues are involved in the learning-teaching process, real or real-like cases are planned (Yapıcıoğlu & Kaptan, 2017). A dynamic structure is created in such a way that many relationships such as science, technology, society and the environment cannot be ignored (Türksever et al., 2020). In this dynamic structure, a socioscientific issue that can be encountered in real life is determined as the focal point of the process, and the contradicting case is discussed and the decision-making process is experienced.

Life science course covers issues intertwined with real life and is a compulsory subject taught in the first three years of elementary school in the Republic of Turkey. The basic structure of this course includes the process by which natural and social facts and events are discussed and processed, the process by which facts and events are connected based on evidence, and the information obtained at the end of this process (Sönmez, 1998). In this course, subjects related to different scientific fields such as Social Studies, Science, History, Geography, Anthropology, Economics, Psychology, Sociology, Law, and Education are discussed in a well-rounded and holistic approach and presented to students (Sözer, 1998). Social elements are heavily involved in life science courses and opportunities are created for students to connect with real life (Ütkür et al., 2016). The aim of the life science course in the institutions of Ministry of National Education (MoNE) is "to raise individuals who have basic life knowledge and skills, who are self-aware, who lead a healthy and safe life, who adopt the values of the society they live in, who are sensitive to nature and the environment, who research, question, produce and love their country." (MoNE, 2018a). Thus, it is aimed to educate students as individuals with basic life skills, to access useful information that they can use in their lives, and to produce original knowledge and ideas using this information (Bayındır, 2007).

The socioscientific issues are directly related to society, which clearly distinguishes the learning and teaching process from other approaches (Tosunoğlu & İrez, 2019). In the Science Education Program (MoNE, 2018b), it was deemed necessary to include socioscientific issues in the learning area of Science-Technology-Society-Environment (STSE) in order to provide students with scientific and moral reasoning skills for solving problems that may be encountered in real life. In the Social Studies Curriculum (MoNE, 2018c), it is aimed that students are able to use the basic concepts and methods of social sciences to solve the problems they encounter. Since life science courses form the basis of the Science and Social Studies courses, which students will take in the next steps of the education, it provides important opportunities to use socioscientific issues-based activities in the education of the students as of the first grades of primary school for the creation and development of prior knowledge. When the special purposes of life science course are examined, it is aimed that students will be able to recognize the environment they live in, use developing and changing information and communication technologies in accordance with their purpose, and gain the ability to

learn basic scientific process skills. At the same time, in this course, primary school teachers are expected to prepare activities that will enable the development of basic life skills necessary for the acquisitions in accordance with the development levels of students (MoNE, 2018a). Considering this point of view, socioscientific issues, connected with real life, should be planned in life science courses, taking into account student levels. And teachers should create discussion environments where students can easily express their opinions. In this way, students will have the opportunity to express their thoughts and criticisms about events and facts of that age. Because the life science courses are opportunities to create an educational environment in which students can reflect on and express their opinions about the events and facts they see, hear or encounter in their immediate surroundings and the larger ones (Şimşek & Yaşar, 2006). The primary school teacher who will achieve this should make the structure of the life science course active by prioritizing the individual, society and nature, and structure the course in order to develop the child's multi-directional development and expected skills as much as possible (Demir, 2016). The life science course inherently focuses on the problems and solutions encountered in real life and enables the student to express himself/herself, which makes it important to use exemplary cases in these courses (Ütkür et al., 2016).

Practitioners of teaching programs are teachers. Teachers guide students in planning and organizing the learning-teaching environment and activities (Board of Education and Discipline [TTKB], 2009). To reach the goals in the life science course curriculum effectively, the competencies and the effectiveness of the primary school teachers who are the practitioners of the program are considered important (Batmaz & Altun, 2019). It is important that the practitioners create teaching environments that enable students to discover and learn information themselves, instead of directly transferring information of teachers by traditional teaching methods (Akpınar & Ergin, 2005). Socioscientific issues integrated into the teaching process and the discussion of these issues become a powerful tool in providing students with critical thinking ability and activating mental and social development (Turan, 2012). In this way, socioscientific issues-based discussions contribute to the multidimensional development of students in areas such as cognitive, affective and social development. In this context, it is necessary to use different approaches that have achieved success in other disciplines in order for the primary school teachers to teach life science courses effectively starting from undergraduate education (Palavan & Başar, 2014). Since content knowledge is seen as an important predictor of effective teaching, the inclusion of socioscientific issues in teacher training will increase their teaching skills (Kılınç et al., 2014). It is an opportunity for teachers to participate in the teaching process in which socioscientific issues are discussed before starting their profession and to transfer their knowledge and experience to their classes after this process (Zohar, 2008). This opportunity indicates that socioscientific issue-based discussion activities turn life science teaching into an interesting and learning-oriented process.

In the learning process, when students have an interest in an issue or a course and have a positive attitude, they can learn more effectively and ultimately they can be more successful (Erden & Akman, 1997). On the contrary, a negative attitude is one of the most important factors behind every underperforming student (Chowdhury et al., 2020). According to Bloom (1995), students' attitudes towards the course and the issue can determine their level of knowledge, performance, desire to get information, their interests and how they approach the course. Attitude emphasizes many aspects of behaviour and comes to the fore in studies on individuals' behaviour (Genç, 2020). Teachers who develop a positive attitude towards the course take action against the difficulties encountered in the teaching process, are motivated and believe that they will develop desired behaviors in students (Pajares & Schunk, 2001). Regardless of the course, it is thought that the attitude development of the students who take their teachers as a role models in the primary school is related to the attitude of the teacher towards the course (Yurtbakan & Altun, 2019). Teachers feel the value of the course and thus increase students' desire towards the lesson (Özçelik, 1992). When teachers get a positive attitude towards life science teaching before starting their profession, this is likely to enable them to increase their performance in teaching, create fun and enjoyable educational environments, and make the learning processes more efficient (Batmaz & Altun, 2019). Because having the knowledge and skills for

the life science course at the desired level will enable them to produce solutions to possible pedagogical problems they will encounter during the course and to teach this course ideally (Kılınç & Uygun, 2015). Likewise, it was observed that primary school teachers who developed a positive attitude towards the life science course included more different types of activities in their lessons (Alak & Nalçacı, 2012). In this context, the researcher considered the attitudes of primary school teachers, who will teach life science in their professional lives, towards this course as important and used socioscientific issues-based discussion activities to increase their attitudes towards this course. In addition, teachers who are the practitioners of the curriculum should be aware of socioscientific issues before their professional life while studying teaching and have knowledge about how these issues are taught in classrooms (Cebesoy & Şahin, 2013). When the studies on socioscientific issues in the relevant literature are examined, it was concluded that most of these studies were related to science courses and attitudes towards socioscientific issues were measured (Altuntaş et al., 2017; Bossér & Lindahl, 2020; Chang et al., 2018; Gürbüzkol & Bakırcı, 2020; Özdemir, 2014; Öztürk & Türkoğlu, 2018; Rahayu et al., 2018; Sıbıç, 2017; Tekin & Aslan, 2019; Türköz & Öztürk, 2020; Türksever et al., 2020; Xiao & Sandoval, 2017; Yolagiden, 2017). Socioscientific issues-based discussions are used as a tool in life science teaching, which makes this study important and original. Based on all of these, this study aims to determine the effect of socioscientific issues-based activities on the attitudes of primary school teacher candidates towards life science teaching. Therefore, the main problem statement of the research is; "Does socioscientific issue-based discussion activities have an effect on the life science teaching attitudes of primary school teacher candidates?". The sub-problems posed based on this main statement are listed below:

1. Is there a significant difference between the mean scores of the attitudes of the primary school teacher candidates towards life science teaching before and after the process of socioscientific issues-based discussion activities in classrooms and the primary school teacher candidates who had courses based on the curriculum?
2. Is there a significant difference between the mean scores of the attitude towards the life science teaching before and after the process when the primary school teacher candidates have socioscientific issues-based discussion activities in classrooms?
3. Is there a significant difference between the mean scores of the attitude towards the life science teaching before and after the process when the primary school teacher candidates have courses based on the curriculum?

Methods

Research Model

The research was conducted by the quantitative research method and its design was the pre-post-test experimental-control group quasi-experimental design. In this design, experimental and control groups are randomly selected from ready-made classes. The same measurement tools are applied to both groups. The experimental procedure is applied only to the experimental group (Balcı, 2013). The experimental process applied in this research is presented in Table 1.

Table 1

Pretest-Posttest Experimental-Control Group Quasi-Experimental Design

Group	Pre-test	Experimental Process (8 weeks)	Post-test
Control Group (Primary School Teacher Candidates)	Attitude Scale of Life Science Teaching	Teaching Based on the Curriculum	Attitude Scale of Life Science Teaching

Experimental Group (Primary School Teacher Candidates)	Attitude Scale of Life Science Teaching	Socioscientific Issue-Based Discussion Activities	Attitude Scale of Life Science Teaching

As seen in Table 1, the Attitude Scale of Life Science Teaching was applied as a pre-test and post-test in order to measure the experimental process. The process step was applied in the courses of life science teaching for both groups. After the experimental process, data obtained from the pre-tests and post-tests were analyzed as between and within the group and interpreted.

Participants

This research was conducted in the fall semester of the 2019-2020 academic year. The criterion sampling method was used in determining the study group for the experimental process, and there were 78 primary school teacher candidates, who are junior students at the Department of Primary Education Classroom Education at the Faculty of Education of a university in the Central Anatolia Region. The criteria used in determining the study group of the research was that the primary school teacher candidates are taking the life science teaching course. The reason why life science teaching is determined as a criterion is that the content of the course is suitable for socioscientific issues that are considered as real life problems, discussion-based activities can be used within the scope of this course, and this course contributes to the professional development of teacher candidates. According to the pre-test results (Table 4), the classes were accepted as identical and one of the classes was determined as the experimental group (N: 39) and the other as the control group (N: 39).

Data Collection

"Attitude Scale of Life Science Teaching" was used as the data collection tool to measure the effect of socioscientific issues-based activities on the attitudes of primary school teachers towards life science teaching. This scale was developed by Sarıkaya et al. (2017). The questionnaire consists of 24 items in 3 subdimensions and the 5-point Likert-type as follows: (1) Strongly Disagree, (2) Disagree, (3) Neutral, (4) Agree, and (5) Strongly Agree. Cronbach's Alpha internal consistency coefficient for the whole scale is 0.93; the split-half reliability calculated via the Spearman-Brown formula is 0.81. In addition, Cronbach's Alpha internal consistency coefficients for sub-dimensions are between 0.86 and 0.89; Spearman-Brown split-half reliability coefficients ranged from 0.84 to 0.87. As a result of confirmatory factor analysis, a three-factor scale structure was verified. In light of these findings, it was decided that the scale created for primary school teacher candidates could be used in determining attitudes towards life science teaching.

In this study, the reliability coefficient was calculated for the sub-dimensions of the Attitude Scale of Life Science Teaching, which was applied to the experimental and control group teacher candidates as a pre-test and post-test, and reliability coefficients were obtained close to the values for which the scale was developed. The results are presented in Table 2.

Table 2

Reliability Analysis Regarding Subdimensions of the Attitude towards Life Science Teaching

Test	Dimension	Number of Items	Cronbach's Alpha	Reliability*
Pre-tests	Liking	12	0.88	Extremely Reliable
	Valuing	8	0.80	Extremely Reliable
	Caring	4	0.84	Extremely Reliable
	The Whole Scale	24	0.92	Extremely Reliable

Post-tests	Liking	12	0.89	Extremely Reliable
	Valuing	8	0.84	Extremely Reliable
	Caring	4	0.79	Highly Reliable
	The Whole Scale	24	0.91	Extremely Reliable

Note. * Büyüköztürk et al., 2012.

Application Process

The course of life science teaching was given to the primary school teacher candidates in the control group based on the course content of the Primary School Teacher Undergraduate Program, specified by the Council of Higher Education (YÖK) and the Life Science Curriculum (MoNE, 2018a) implemented in primary schools. This process was routinely carried out by the researcher based on traditional teaching methods. Courses taught by traditional teaching is defined as a form of class conduct in which there are methods such as lecturing, question-answer under the teacher's leadership and course are mostly conducted by the teacher (Gürses, 2010). In the control group, the researcher structured the subjects of life science teaching course with the traditional teaching specified by Gürses (2010), and frequently used the teaching methods of lecturing, question-answer and large group discussion during the course and conducted the course as teacher-centered based on the subjects and concepts in the Primary School Life Science Teaching Program (2018a).

In the experimental group, the researcher conducted the course of life science teaching based on the course content of the Primary School Teaching Undergraduate Program, specified by YÖK, diversified the subjects by visual and auditory tools and tried to receive feedback about the subject by using the question-answer method. After the completion of that week's course issues, different socioscientific issues-based discussion activities were organized for the primary school teacher candidates for the rest of the course. The socioscientific issue associated with the Life Science Teaching Program was presented to the students in the form of a scenario (Table 3) and supported by visual and auditory tools. The random discussion groups were formed and primary school teacher candidates were asked to analyze socioscientific issues, reason and decide with different discussion techniques. During the process, in order to save time, the experimental group primary school teacher candidates were expected to form discussion groups with a maximum of six people each week based on classroom seating arrangement. The researcher took precautions by making a change of location and warnings to ensure that the same teacher candidates do not form a discussion group every week. The researcher became a guide, answered the questions about the socioscientific issue-based scenarios created by walking around the classroom and encouraged the candidates to discuss. The primary school teacher candidates were asked to express their opinions and make a decision in the group. Afterwards, the intergroup discussion was started and the decisions were discussed with the whole class. The issue was summarized by making feedback corrections, if any, and the process was terminated after being evaluated. This process took an average of 30 minutes per week and discussion activities focused on socioscientific issues lasted for 8 weeks.

Scenarios based on socioscientific issues with a focus on the Life Studies Curriculum (2018a) were prepared by the researcher. These scenarios were presented to two experts in terms of conformity to the purpose, clarity of the statements, and validity of the scope. After these expert opinions, the scenarios were presented to the primary school teacher candidates who were not included in the sample group. Then the scenarios were finalized and ready for implementation. The scenarios, the related issues and the discussion activities are presented in Table 3.

Table 3

Information Related to the Prepared Scenarios

Week	Socioscientific Issues-Based Scenarios	The Related Life Science Acquisitions (MoNE, 2018a)	The Discussion Activities:
1	Hydraulic Power Plant	HB.3.6.4 They give examples of the effect of people on natural elements by thinking about their immediate environment.	Buzz Groups
2	Electric and Autonomous Vehicles	HB.2.4.2. They comply with the safety rules while travelling by transportation vehicles.	Brainstorm
3	Genetically Modified Organisms (GMO)	HB.3.3.3. They eat seasonal foods to protect their health. HB.3.6.2. They investigate the growing conditions of fruits and vegetables.	Thinking Workshop
4	Mines	HB.3.6.4. They give examples of the effect of people on natural elements by thinking about their immediate environment. HB.3.6.6. They give examples of the contribution of recycling to themselves and the environment where they live.	Debate
5	Global Warming	HB.1.2.5. They use home resources efficiently. HB.2.1.6. They take care in using school resources and belongings.	Six Thinking Hats*
6	Robotic Technology	HB.3.2.5. They give examples of the contribution of household appliances and technological products to our lives.	Argumentation*
7	Nuclear Power Plant	HB.1.2.5. They use home resources efficiently. HB.2.4.5. They are sensitive about the safe use of technological tools and equipment.	Six Thinking Hats*
8	Biotechnological Developments (Vaccination-Stem Cell-Cloning)	HB.2.1.1. They introduce themselves by their different characteristics. HB.2.5.8. They observe the production activities in their immediate surroundings. HB.1.3.2. They notice the measures to be taken to protect their health.	Argumentation*

Note. *Since it requires more practice, it has been used in two different scenarios for better comprehension by teacher candidates.

The class duration of the experimental group was levelled with that of the control group by the researcher, taking into account the content of that week's life science teaching course subjects. This process continued for 8 weeks in an academic semester.

Data Analysis

SPSS and Excel package programs were used in the analyzes related to the Attitude Scale of Life Sciences Teaching, which was applied before and after the socioscientific issue-based discussion activities. In the analysis of the data, the mean scores in pre-tests and post-test of primary school teacher candidates in control and experimental groups about life science teaching and the sub-dimensions mean scores were checked with the Levene test for the homogeneity of variances and all dimensions were found as p>05. Kolmogorov-Smirnov[a] and Shapiro-Wilk tests were conducted to test the normality of data distribution. In this study, since the number of data was more than 29, it was examined with the results of the Kolmogorov[a]-Smirnova test. The pre-post test normality test results of the Attitude Scale of Life Science Teaching applied to the student group are presented in Table 4.

Table 4

Results of the Pre-test and Post-test Normality Test

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Experimental Group	Pre-test	0.099	39	0.200*	0.922	39	0.010
	Post-test	0.095	39	0.200*	0.966	39	0.271
Control Group	Pre-test	0.134	39	0.076*	0.913	39	0.005
	Post-test	0.132	39	0.085*	0.913	39	0.005

Note. *p>0.05

In the Kolmogorov[a]-Smirnov normality analysis, it was determined that both the pre-test and post-test data of the Attitude Scale of Life Science Teaching showed a normal distribution (p> 0.05) and the coefficients of skewness and kurtosis were in the range of -2 to +2. In this context, as a result of the analyzes, it was decided to use parametric tests in pre-test and post-test data analysis. In addition, it was considered to use covariance analysis (ANCOVA) in order to test the post-test mean scores of attitude towards life science teaching by controlling the pre-test scores of the experimental and control group primary school teacher candidates. However, this test was abandoned because the data could not provide a significant linear relationship between the covariate (pre-test) and the dependent variable (post-test), which is one of the assumptions of ANCOVA (p>0.05).

The difference between the pre-post test mean scores of the primary school teacher candidates in the experimental and control groups were analyzed using the dependent and independent groups t-tests and the effect size was calculated (eta squared ($\acute{\eta}^2$)) according to the variances between the scores. Effect size is defined as a standardized measurement of the difference between mean scores (Cohen et al., 2018) and reported as the standardized difference. To calculate the effect size, the method proposed by Cohen (*Cohen's d* formula) was used.

Findings

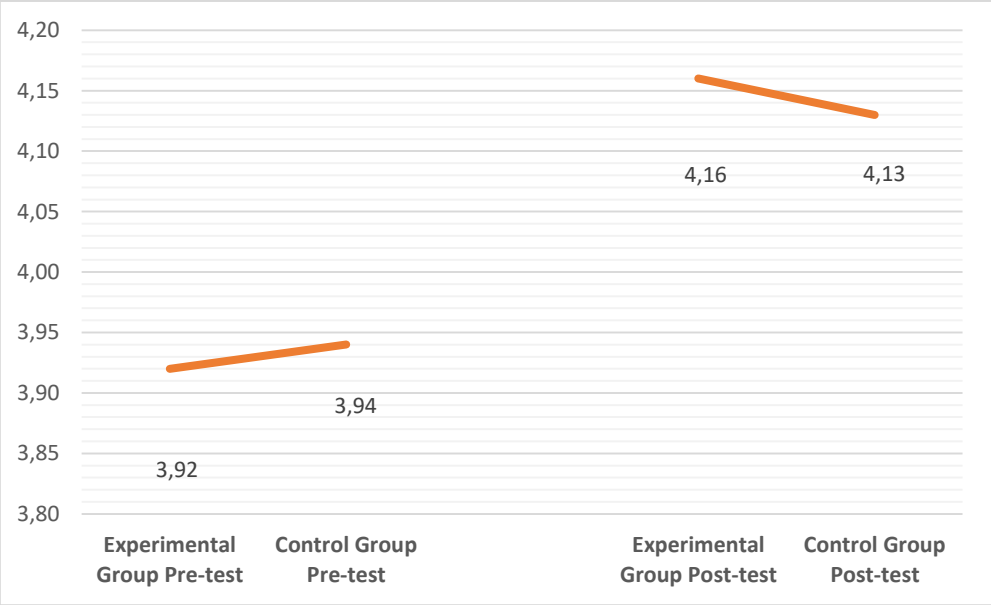
This study examines the effect of socioscientific issues-based activities on the attitudes of primary school teachers towards life science teaching. Findings for the sub-problems investigated for this purpose are given below:

Findings Regarding the First Sub-Problem

The mean scores of the attitude towards the life science teaching of the primary school teacher candidates before and after the process socioscientific issues-based discussion activities in classrooms and the primary school teacher candidates who had courses based on the curriculum are calculated and compared in Figure 1.

Figure 1

Comparison of the Pre-Test and Post-Test Mean Scores of the Experimental and Control Group Primary School Teacher Candidates on the Attitude towards Life Science Teaching



It has been calculated that the mean score of the attitude towards the life science teaching before the process of the experimental group was lower than the control group, however, after the process, the mean score was calculated to be higher. The pre-test mean scores of the attitude towards life science teaching of the experimental and control group primary teacher candidates were compared by the independent groups t-test and the results are presented in Table 5.

Table 5

Comparison of the Pre-Test Mean Scores of the Experimental and Control Group Primary School Teacher Candidates on the Attitude towards Life Science Teaching By Independent Groups T-Test

		N	$\overline{X}$	sd	df	t	p	ή²
Pre-Test	Experimental Group	39	3.92	0.58	76	-0.092	0.927	-
	Control Group	39	3.94	0.51				

Note. t(76)=-0.092; p=0.927

As seen in Table 5, it was determined that there was no statistically significant difference between the experimental and control group primary school teacher candidates' pre-test mean scores of the attitude towards life science teaching (p>0.05). This can be interpreted as that both groups had similar attitudes towards life science teaching before the process. The post-test means scores of the attitude towards life science teaching of the experimental and control group primary teacher candidates were compared by the independent groups t-test and the results are presented in Table 6.

Table 6

Comparison of the Post-Test Mean Scores of the Experimental and Control Group Primary School Teacher Candidates on the Attitude towards Life Science Teaching By Independent Groups T-Test

		N	$\overline{X}$	sd	df	t	p	$\acute{\eta}^2$
Post-Test	Experimental Group	39	4.16	0.37	76	0.293	0.793	-
	Control Group	39	4.13	0.51				

Note. t(76)=0.293; p=0.793

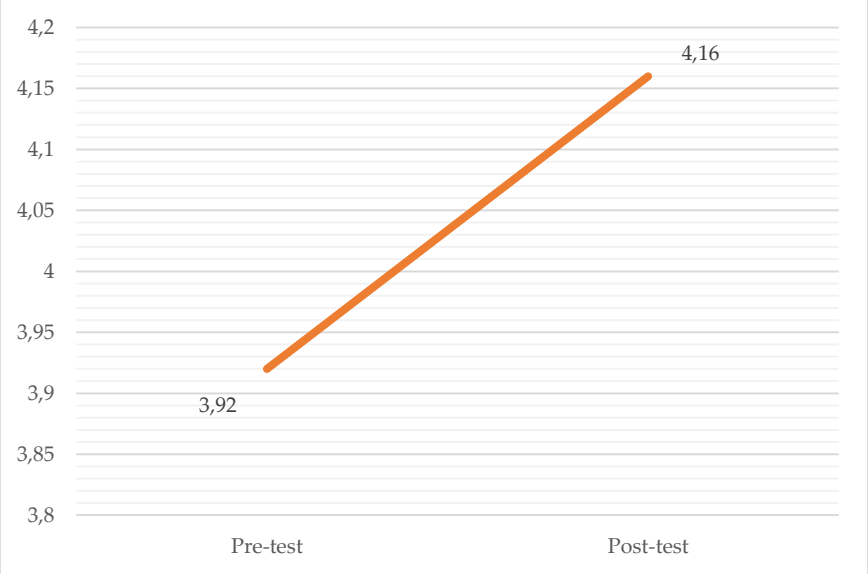
As seen in Table 6, it was determined that there was no statistically significant difference between the experimental and control group primary school teacher candidates' post-test mean scores of the attitude towards life science teaching (p>0.05). However, at the end of the process, a 0.24-point change was observed in the attitude towards life science teaching means scores of the experimental group primary teacher candidates, while a change of 0.19 was observed of the control group primary teacher candidates. This situation can be interpreted as the socioscientific issues-based discussion activities in classrooms increases the means scores of the attitude towards the life science teaching of primary school teacher candidates compared to the courses based on the curriculum.

Findings Regarding the Second Sub-Problem

The experimental group participants' mean scores of the attitude towards life science teaching before and after the socioscientific issues-based discussion activities are calculated and compared in Figure 2.

Figure 2

The Comparison of Primary School Teacher Candidates' Means Scores of the Attitude towards Life Science Teaching Before and After the Socioscientific Issues-Based Discussion Activities



It was found that the participants' mean scores of attitude towards life science teaching were higher after the socioscientific issues-based discussion activities compared to their mean scores before

the activities. The pre-test and post-test mean scores of the attitude towards life science teaching of the experimental group teacher candidates were compared by the dependent groups t-test and the results are presented in Table 7.

Table 7

The Comparison of Primary School Teacher Candidates' Mean Scores of the Attitude towards Life Science Teaching Before and After the Socioscientific Issues-Based Discussion Activities by Dependent Groups T-Test

	N	$\overline{X}$	sd	df	t	p	ή²
Pre-test	39	3.92	0.58	38	-2.165	0.037	0.51
Post-test	39	4.16	0.37				

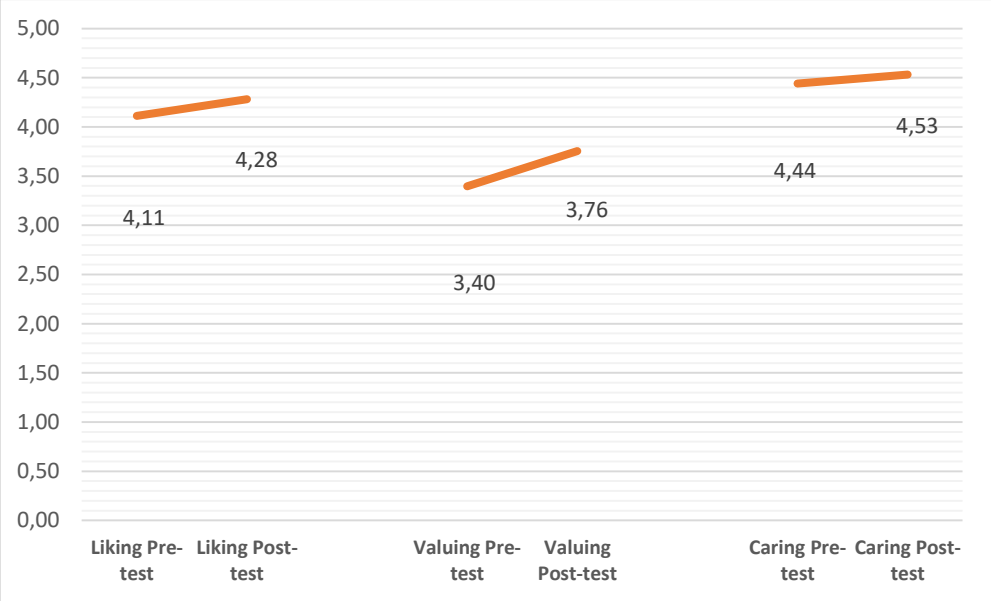
Note. t(38)=-2.165; p=0.037; ή2=0.51

As seen in Table 7, the participants' mean scores of attitude towards life science teaching were higher after the socioscientific issues-based discussion activities compared to their pre-test mean scores. It is seen that the difference between the participants' mean scores of attitude towards life science teaching before and after the socioscientific issues-based discussion activities is statistically significant ($p < 0.05$). The effect size of the difference between the mean scores of the pre-post test ($ή^2$) is calculated as 0.51 and it is considered as a moderate effect since it is 0.5>d>0.8. This can be interpreted that socioscientific issues-based discussion activities improved the attitudes of the primary school teacher candidates towards life science teaching at a moderate level.

The experimental group participants' subdimension mean scores of the attitude towards life science teaching before and after the socioscientific discussion activities are calculated and compared in Figure 3.

Figure 3

The Comparison of Primary School Teacher Candidates' Subdimension Mean Scores of the Attitude towards Life Science Teaching Before and After the Socioscientific Issues-Based Discussion Activities



It was found that the participants' subdimension mean scores of attitude towards life science teaching were higher after the socioscientific issues-based discussion activities compared to their

mean scores before the activities. The pre-test and post-test subdimension mean scores of the attitude towards life science teaching of the experimental group teacher candidates were compared by the dependent groups t-test and the results are presented in Table 8.

Table 8

The Comparison of the Mean Scores of the Attitude towards Life Science Teaching Before and After The Socioscientific Issues-Based Discussion Activities by Dependent Groups T-Test

		N	$\overline{X}$	sd	df	t	p	ή²
Liking	Pre-test	39	4.11	0.62	38	-1.479	0.147	-
	Post-test	39	4.28	0.34				
Valuing	Pre-test	39	3.40	0.67	38	-2.482	0.018*	0.57
	Post-test	39	3.76	0.59				
Caring	Pre-test	39	4.44	0.71	38	-0.615	0.542	-
	Post-test	39	4.53	0.52				

Note. *t(38)=-2.482; p=0.018; ή2=0.57

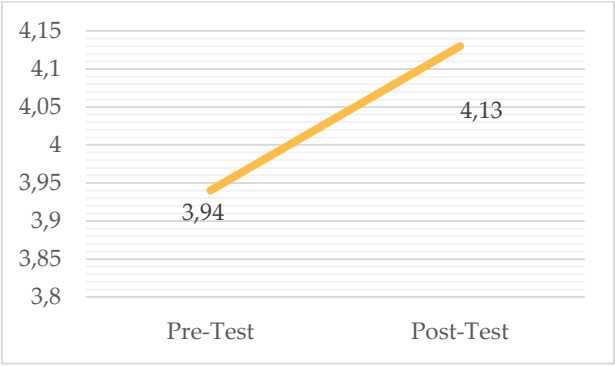
As seen in Table 8, the participants' subdimension mean scores of attitude towards life science teaching were higher after the socioscientific issues-based discussion activities compared to their pre-test subdimension mean scores. However, it was found that the difference between the mean scores of subdimensions of "liking" and "caring" is not statistically significant($p<0.05$). It was determined that the difference between the mean scores of the subdimension of "valuing" is statistically significant ($p>0.05$). The effect size of the difference between the "valuing" subdimension mean scores of the pre-post test ($ή^2$) is calculated as 0.57 and it is considered a moderate effect since it is 0.5>d>0.8. This can be interpreted that socioscientific issues-based discussion activities improved the "valuing" subdimension of the primary school teacher candidates about life science teaching at a moderate level.

Findings Regarding the Third Sub-Problem

The control group participants' mean scores of the attitude towards life science teaching before and after the curriculum-based course process are calculated and compared in Figure 4.

Figure 4

The Comparison of Primary School Teacher Candidates' Means Scores of the Attitude towards Life Science Teaching Before and After the Curriculum-Based Course Process



It was found that the participants' mean scores of attitude towards life science teaching were higher after the curriculum-based course process compared to their mean scores before the course process. The pre-test and post-test mean scores of the attitude towards life science teaching of the control group teacher candidates were compared by the dependent groups t-test and the results are presented in Table 9.

Table 9

The Comparison of Primary School Teacher Candidates' Means Scores of the Attitude towards Life Science Teaching Before and After the Curriculum-Based Course Process

	N	$\overline{X}$	sd	df	t	p	$\acute{\eta}^2$
Pre-test	39	3.94	0.51	38	-1.538	0.132	-
Post-test	39	4.13	0.51				

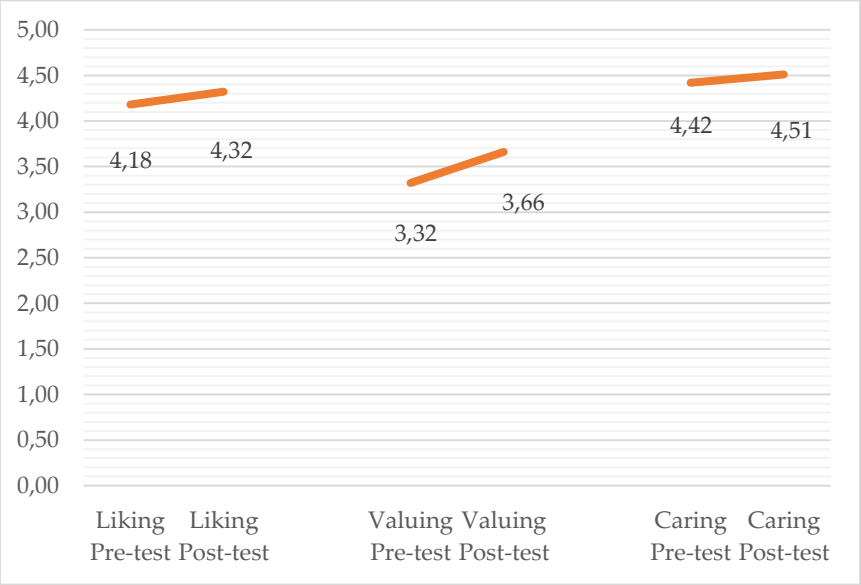
Note. t(38)=-1.538; p=0.132

As seen in Table 9, the participants' mean scores of attitude towards life science teaching were higher after the curriculum-based course process compared to their pre-test mean scores. It is seen that the difference between the participants' mean scores of attitude towards life science teaching before and after the curriculum-based course is not statistically significant ($p<0.05$). In this context, it was interpreted that the course process routinely followed and specified by YÖK and which is instructor-centered did not create a significant effect on the improvement of primary school teacher candidates towards life science teaching.

The control group participants' subdimension mean scores of the attitude towards life science teaching before and after the curriculum-based course process are calculated and compared in Figure 5.

Figure 5

The Comparison of Primary School Teacher Candidates' Subdimension Mean Scores of the Attitude towards Life Science Teaching Before and After the Curriculum-Based Course Process



It was found that the participants' subdimension mean scores of attitude towards life science teaching were higher after the curriculum-based course process compared to their mean scores before the activities. The pre-test and post-test subdimension mean scores of the attitude towards life science teaching of the control group teacher candidates were compared by the dependent groups t-test and the results are presented in Table 10.

Table 10

The Comparison of Primary School Teacher Candidates' Subdimension Mean Scores of the Attitude towards Life Science Teaching Before and After the Curriculum-Based Course Process by Dependent Groups T-Test

		N	$\overline{X}$	sd	df	t	p	$\acute{\eta}^2$
Liking	Pre-test	39	4.18	0.48	38	-1.036	0.307	-
	Post-test	39	4.32	0.56				
Valuing	Pre-test	39	3.32	0.65	38	-1.997	0.053	-
	Post-test	39	3.66	0.63				
Caring	Pre-test	39	4.42	0.69	38	-0.604	0.549	-
	Post-test	39	4.51	0.69				

As seen in Table 10, the participants' subdimension mean scores of attitude towards life science teaching were higher after the curriculum-based course process compared to their pre-test subdimension mean scores. However, the difference between the mean subdimension mean scores was not statistically significant ($p>0.05$). It can be interpreted that a course process based on the curriculum did not have a significant effect in developing the sub dimensional attitudes (liking, valuing, and caring) of primary school teacher candidates about life science teaching.

These findings suggest that that socioscientific issues-based discussion activities significantly improved the "valuing" subdimension mean scores and attitude mean scores of the primary school teacher candidates towards life science teaching at a moderate level.

Discussion, Conclusion and Implications

This study revealed that the effect of socioscientific issues-based activities on the attitudes of primary school teacher candidates towards life science teaching. While the courses with the teacher candidates in the control group were given on the basis of the curriculum determined by the Council of Higher Education (YÖK), the experimental group teacher candidates held socioscientific discussion activities for eight weeks. The mean scores of the attitude towards the life science teaching before and after the process of the primary school teacher candidates were compared. As a result of the research, it was determined that there was no statistically significant difference between the experimental and control group primary school teacher candidates' mean scores for both pre-test and post-test of the attitude towards life science teaching. However, at the end of the process, it was observed that the increase in the average scores of the attitude towards life science teaching of the experimental group primary teacher candidates was higher than that of the control group primary teacher candidates. In addition, the attitude mean scores of primary school teacher candidates towards the life science teaching in the pre-test and post-test were compared. This study revealed that the primary school teacher candidates in both groups (experimental and control) improved their attitude towards life science teaching. It was seen that the post-test attitude mean scores of the control group participants were higher than their pre-test mean scores, but the difference between the participants' mean scores is not statistically significant. However, the post-test attitude mean scores of the experimental group participants were higher than their pre-test mean scores and the difference between the mean scores

was statistically significant. The effect size of the difference between the pre-post test mean scores was calculated and it was observed that the experimental group primary school teacher candidates improved their attitudes towards life science teaching at a moderate level. When evaluated in this context, it was concluded that the socioscientific issues-based discussion activities in classrooms increase the means scores of the attitude towards the life science teaching of primary school teacher candidates compared to the courses based on the curriculum.

In the relevant studies conducted with primary school teacher candidates, it was observed that the candidates' attitudes towards the life science teaching course were high (Batmaz & Altun, 2019; Çetin, 2018; Yurtbakan & Altun, 2019). Individuals' attitude towards an event or fact generally reflects their behavior pattern towards that object. There are cognitive, emotional and behavioral elements in the formation of this attitude and the first step to create this attitude is to create awareness (Ajzen & Fishbein, 1977). Negev et al. (2008) stated in their study that awareness in individuals will make people have a strong relationship in developing attitudes and behaviors. This awareness started with the teaching process with both primary school teacher candidates in this study, and it was tried to make people get knowledge and skills for their professional lives. However, the socioscientific issues-based discussions conducted with the experimental group primary school teacher candidates highlighted the awareness and created a significant change in the attitude mean scores. Socioscientific issues, by their nature, deal with real-life problems, and these topics support the development of higher-order thinking skills, as well as encourage them to develop a positive attitude towards science and the solution of possible problems (Sadler, 2009). As we move from traditional teaching and learning to exploratory ones, students' minds tend to research and as a result, they learn better (Harris et al., 2001). Considering the three components of attitude, emotional, cognitive and behavioral (Ülgen, 1996), a better learning activity can affect the attitude towards the course in a positive way. When interpreted considering this point of view, the new knowledge they acquired and learned in the additional socioscientific issues-based discussions to the classroom teacher candidates' attitudes towards the course may have been effective.

It was found that the control group participants' subdimension (liking, valuing, caring) mean scores of attitude towards life science teaching were higher after the curriculum-based course process compared to their mean scores before the course process. However, the difference among all subdimension mean scores are not statistically significant. It was found that the experimental group participants' subdimension mean scores of attitude towards life science teaching were higher after the socioscientific issues-based discussion activities compared to their mean scores before the activities. It was revealed that the difference between the mean scores of subdimensions of "liking" and "caring" is not statistically significant and the difference between the mean scores of the subdimension of "valuing" is statistically significant. The effect size of the difference between the pre-post test mean scores was calculated and it was concluded that the experimental group primary school teacher candidates improved their attitude of valuing towards life science teaching at a moderate level. In the study conducted by Yurtbakan and Altun (2019), the mean score of the subdimension of valuing attitude was found to be lower than the other two subdimensions mean scores. In the interviews with the primary school teachers in the same study, it was concluded that no discussion-based teaching method was used in life science courses and the case study method was used very little. The socioscientific issue-based discussion activities were up-to-date, interesting and based on real examples in life, which was effective in the improvement of the valuing attitude in the primary school teacher candidates towards the course. According to Genç (2020), in this age where we encounter many different situations, we should carry our students beyond knowing the basic structures of socioscientific issues. We should expect them to pay attention to these issues, develop ideas, express opinions, and conduct analysis, synthesis and discussion on these issues. This can be achieved by the teacher valuing the socioscientific issues as a role model and having an enthusiastic approach.

Among the main competencies of this course teaching period, there are the primary school teacher's ability to use efficient teaching strategies, methods and techniques related to the life science course and their skill to make students interested in this course and the course period (Bektaş, 2007).

In a study, it was concluded that primary school teacher candidates' attitudes towards life science teaching were positively correlated with their self-efficacy perceptions (Batmaz & Altun, 2019). In another study, it was determined that teacher candidates' self-efficacy perceptions for integrating socioscientific issues were low (Sıbıç, 2017). Therefore, like this study, socioscientific issue-based discussion activities that can be used in the teaching process can be used to increase the attitude towards the course, as well as play a mediating role in increasing candidate teachers' perceptions of self-efficacy. However, it is thought that the education based on socioscientific issues-based approach will contribute to the training of more professional teachers (Yapıcıoğlu & Kaptan, 2017). Because teachers are expected to be effective, self-confident and participatory individuals in order to have competencies in their profession, and practices in accordance with this goal are expected from the education faculties of universities in training a qualified teacher (Kılınç & Uygun, 2015). Presley et al. (2013) stated that teachers who have sufficient field knowledge about socioscientific issues have improved in guiding their students about these issues in the classroom and providing an environment where they can express their opinions. Sadler (2011), on the other hand, emphasizes the need for experienced teachers who can give the necessary feedback on socioscientific issues that students frequently encounter in daily life, the media or different environments. This study conducted by the researcher can be evaluated as contributing to the professional development of primary school teacher candidates.

Individuals who are accustomed to traditional methods find it easier for the teacher to explain the existing information due to the concern that they will not understand the subject or that their scores for the course will decrease, and they keep away from the new methods (Can & Semerci, 2007). Teachers may not use the variety of methods and techniques due to the obstacles such as the fact that the organization of activities takes too much time, the content is insufficient, the information and concepts contained in the themes are not suitable for the readiness levels of the students, and the themes do not consist of interesting texts (Öztürk & Kalafatçı, 2017). However, most teachers prefer to include topics related to basic science disciplines in their classes due to reasons such as concerns about classroom management, lack of knowledge about the nature of science and the sociological, ethical, political and economic dimensions of science. So, they avoid teaching socioscientific issues (Christenson et al., 2014). For this reason, teacher candidates should have different experiences in gaining professional skills and competencies and should be directed to different strategies that they can use in and out of the classroom in the future. Developing alternative solutions such as using the appropriate learning model or learning strategy that will enable students to understand their conceptual understanding can respond to how to overcome learning deficiencies and misconceptions (Samsudin, et al., 2021). Supporting life science teaching with socioscientific issues and related discussion activities in this study has created an opportunity for primary school teacher candidates. Discussion and decision-making process on different socioscientific issues in the classes will be possible by the use of teaching methods, techniques and approaches that will improve high-level thinking skills (Altuntaş et al., 2017). According to Topçu (2015), creating a connection between socioscientific issues and the curriculum and supporting teachers on this issue can lay the groundwork for an effective teaching. Teachers are expected to notice which titles, objectives, and concepts socioscientific issues are related to and associate this awareness with classroom practices (Tosunoğlu & İrez, 2019). Therefore, the inclusion of socioscientific issues in the vocational training of teacher candidates will improve their field and pedagogical knowledge and improve their proficiency (van der Zande, 2011).

Life science course enables the children to acquire accurate information and necessary skills about their environment and environmental problems from an early age by examining the social and cultural environment in which they live (Binbaşıoğlu, 2003). The positive attitudes of primary school teachers and the candidates towards this compulsory and important course in the first years of basic education are considered important in gaining the expected behavior and skills prescribed by the program (Sarıkaya et al., 2017). Socioscientific issues-based teaching activities, which are mostly used in researches on science courses, were used by the researcher in terms of life science teaching in this

study. When we evaluate from this point of view, the socioscientific issues-based discussion activities can be used as a tool to improve attitude towards the course. Since socioscientific issues are frequently encountered as a part of daily and social life, associating them with life science courses during the preparation for the profession may arouse curiosity in teacher candidates. Therefore, the participation in the course is higher compared to the course based on traditional teaching while the attitude towards the course changes. However, this experience in undergraduate education should be considered as an opportunity for prospective classroom teachers. Teacher candidates should be able to use them as a strategy by which they can introduce their students to socioscientific issues that are intertwined with life for the first time. Considering all of these, the socioscientific issue-based teaching activities, which require discussion and decision-making, are recommended to be used in the professional education of primary school teacher candidates and in developing attitudes towards a different discipline such as the science course.

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