Science Education International
35(3),219-228
https://doi.org/10.33828/sei.v35.i3.5

ORIGINAL ARTICLE

Primary School 4th-Grade Students' Attitudes Toward Socioscientific Issues and Question Asking: Philosophy for Children

Ergün Yurtbakan[1]*, Onur Batmaz[2]

[1]Faculty of Education, Uşak University, Uşak, Türkiye, [2]Vocational School of Health Services, Yozgat Bozok University, Yozgat, Türkiye

***Corresponding Author:** ergun.yurtbakan@usak.edu.tr

ABSTRACT

In this study, the effect of philosophy for children on primary school 4th-grade students' attitudes toward socioscientific issues (SSIs) and asking questions will be examined. A quasi-experimental design will be used in the study. In the study, 48 (experimental group [EG]: 24, control group [CG]: 24) primary school 4th-grade students studying in a primary school in the Derince district of Kocaeli province were included in the study with convenient case sampling. The data in the study were collected with the "Question Asking Attitude Scale" and "Children's Attitudes Toward Socioscientific Issues Scale." The post-test scores of the experimental and CG students' attitudes toward SSIs and asking questions were analyzed by the Mann–Whitney U test and the change between the pre- and post-test scores of the students in the experimental and CG s was analyzed by the Wilcoxon signed-rank test. As a result of the analyzes, it was revealed that although both the philosophy for children intervention (EG) and the traditional reading intervention (CG) increased the primary school 4th-grade students' attitudes toward SSIs and asking questions, it was not at a statistically significant level. However, students in the EG discussing SSIs through the philosophy for children application significantly increased their awareness of SSIs and asking questions compared to the students in the CG.

KEY WORDS: Philosophy for children; primary school students; question-asking attitude; socioscientific

INTRODUCTION

The rapid increase in human population in recent years has increased the demand for health services, food resources, and energy resources. To meet the increasing needs of society, developments in science and technology are utilized in areas such as health, agriculture, industry, and education. Although improvements in science and technology are useful in meeting the needs of people, they can negatively affect the environment and human life. For this reason, the use of innovations in the field of science and technology is discussed among people, scientists, and those who govern the country (Albe, 2008; Levinson, 2006). These problem-based issues based on scientific concepts that cause discussion among people are called socioscientific issues (SSIs) (Sadler, 2004). SSIs include climate change (Zangori et al., 2017), water fluoridation (Sadler, 2011), volcanoes, vaccination, water resources, nutrition, family planning, use of alcohol in medicine, biodiversity, cultural tourism (Wiyarsi and Çalik, 2019), energy resources (Topçu and Atabey, 2017), global warming (Al, 2015), organic agriculture, ready-to-eat food problems (Yurtbakan, et al., 2021), genetically modified organics (Chang and Chiu, 2008; Demiral and Çepni, 2018; Kılınç et al., 2013), genetic engineering (Sadler and Zeidler, 2004), drug use (Zeidler et al., 2008), organ transplantation, alternative medicine (Quinn et al., 2016), alternative fuels, and cloning (Sadler, 2004). In other words, it is seen that almost all of the SSIs are related to health and environmental problems (Yahaya et al., 2016).

SSIs expect students to make decisions from a scientific perspective by comparing real and ethically complex situations (Boogeholz and Barkmann, 2005; Khishfe, 2012). To facilitate students' discussion of SSIs, students should be aware of the complexity of the subject, conduct research after identifying the knowledge they lack, review it from the perspective of their peers, be skeptical of information, and know the superiority and limitations of science in solving SSIs (Zeidler et al., 2019). However, SSIs that will reveal the impact of local and cultural values should be included in the curriculum since students' ignorance of science topics and their inability to realize ethical and moral dimensions make it difficult for them to interact with their friends about SSIs (Çakır Yıldırım and Öztürk, 2021; Lewis and Leach, 2006; Vishal Kumar et al., 2024).

Teachers in schools have a great role in attracting students' attention to SSIs. First, teachers' awareness and knowledge levels about SSIs should be increased. For this purpose, in-service training on SSIs should be provided to teachers who are pedagogically inadequate, who experience inadequacy in developing materials for SSIs, and who mention insufficient time in the curriculum (Chen and Xiao, 2021; Hancock et al., 2019; Tidemand and Nielsen, 2017). Then, teachers should

enable their students to develop arguments about SSIs by creating discussion environments about problems of public importance in their lessons. In this way, responsible and science-literate citizens that democratic societies need can be raised (Osborne et al., 2003; Zeidler, 2014). Students' awareness and sensitivity toward SSIs can be increased both by allocating space for SSIs in curricula and by teachers who are trained in their field to include SSIs in their lessons. As a result, students can improve positive attitudes toward SSIs and become aware of their responsibilities toward society and the environment. In addition, drawing attention to SSIs enables students to develop positive motivation and positive attitudes toward science (Gürbüzkol and Bakırcı, 2020; Stenseth et al., 2016), to understand the theory of science, to increase their content knowledge, to improve their critical thinking, discussion (Rudsberg et al., 2013); moral reasoning (Lee et al., 2012), decision-making (Eastwood et al., 2012), higher order thinking (Dori et al., 2003; Sadler et al., 2016), and argumentation skills (Dawson and Venville, 2010; Kolsto, 2006). In fact, choosing the problems in the region where students live as an SSI improves students' scientific thinking habits and increases their sensitivity to SSIs (Wiyarsi and Çalik, 2019).

Students' attitudes toward SSIs and inquiry skills affect each other (Alkış Küçükaydın, 2020). Questioning is done by asking questions in the process of seeking information and reaching the truth (Kumari et al., 2015). It can be said that students' questioning skills are affected by the development of their questioning skills. It is clear that questions help to determine what and how much a person knows and interprets (Wasserman, 1991). Asking questions is one of the skills that should be taught to develop students' metacognitive skills (Garcia and Pearson, 1990). For this reason, teachers should ask questions not to a limited number of students in their classes but to all students equally (Erkuş and Durmuş, 2015; Jones, 1990). In addition, teachers should be models for their students by asking high-level cognitive questions that will reveal their students' thoughts, clarify their thoughts, and facilitate them to go deeper into their thoughts (Brualdi, 1998; Chin, 2006). They should also encourage their students to ask questions by caring about their questioning skills (Belcastro, 2017). To encourage their students to ask questions, they should support them in asking questions through written and verbal ways, give time for their students to ask questions, and include their students' questions in the learning-teaching process (Pedrosa de Jesus et al., 2012). Since the ability to ask questions is contagious (Leslie, 2015), teachers can use methods such as the question balls technique and philosophy for children (Özcan et al., 2023a; Saylık et al., 2017) to help students develop their questioning skills.

In classrooms where philosophy for children is practiced, classroom teachers observe that students' skills of questioning, defending their thoughts, looking from different perspectives, and expressing themselves improve (Avcı, 2023). In addition, philosophy for children increases the academic achievement of primary school students by supporting their reasoning skills (Gorard et al., 2016). In fact, the critical thinking skills of primary school students are also improved with the philosophy for children practice (Murris and Thompson, 2016). Philosophy for children is explained as discussing philosophical concepts such as truth, beauty, reality, justice, and knowledge with a mentor based on a story or a case in a text (Akkocaoğlu, 2015). For children to grow up as thinkers and producers, if philosophy education for children is not provided in the early stages, children lose their curiosity in the following years and give up asking questions and questioning (Özkan, 2020). Philosophy for children (P4C) is used as a student-centered learning and teaching method based on the community of inquiry and interactive teaching proposed by Matthew Lipman (Xu, 2022).

In the process of philosophy for children, the discussion process is carried out by sharing a stimulus such as a story, poem or object, picture poem, or object, which are works of children's literature, and then discussing a question selected among the questions produced by the students about the stimulus (Fisher, 2008; Mohr Lone, 2017; Trickey and Topping, 2004; Worley, 2019). In philosophy for children, a guide is needed to facilitate the discussion process. While philosophizing for children in schools, the role of a guide is undertaken by teachers (Kennedy, 2015). However, there are some rules that guides should follow in the process of inquiry in philosophy for children. Teachers should not share their own thoughts with students in the process of philosophy for children, encouraging them to think of different ideas, not to miss any of the students' opinions, to prevent going beyond the subject, to mobilize students' thoughts by asking the right questions at the points where the discussion process is blocked, to write the arguments of the discussed subject where they can see, give voice to students who will put forward sound arguments and refute sound arguments, involve students who are distracted and have difficulty in following the process through methods such as creative drama, make sure that students understand each other and give students the necessary thinking time to understand the questions asked (Birnbacher and Ladwig, 2006; Gatley, 2020; Vansieleghem, 2005; Yenisoy Şahin, 2023). For this reason, the teacher who plays a guiding role in the inquiry process should be trained in philosophy for children.

It is seen that teachers who receive in-service training on philosophy for children can have interactive and inquiry-based discussions and are willing to use philosophy for children in their classrooms (Lam, 2021; Motherway, 2022). However, during the preparation process, teachers have difficulties in asking questions (open-ended) that will enable students to think at a higher level, providing the necessary stimuli (stories, movies, visuals, etc.) and deepening students' discussions (Akkocaoğlu Çayır, 2023; Kodaz Öcal and Aybek, 2023). SSIs can help teachers in both providing convenient stimuli and deepening the discussion in philosophy for children's practice. Because SSIs are open-ended, complex issues with no definite answer and prone to discussion (Topçu and Atabey, 2017). SSIs are structured problems in which individuals need to reason,

evidence-based, evidence should be collated and analyzed within the framework of scientific rules (Zeidler et al., 2008). The characteristics of SSIs can create a democratic discussion environment for students in philosophy for children and enable individuals to refute each other's arguments thanks to their competent questioning skills.

In the literature, a scale was developed to determine student attitudes toward SSIs (Klaver et al., 2021), studies on SSIs were examined (Vishal Kumar et al., 2024), teachers' pedagogical content knowledge toward SSIs was measured, curriculum teaching on SSIs was examined (Friedrichsen et al., 2021; Minken et al., 2021), attitudes toward SSIs were examined (Hastürk and Ökkeşoğulları, 2021; Stenseth et al., 2016), students' sensitivity about different SSIs and the effect of SSIs on their discussion (Yurtbakan, et al., 2021), reasoning (Zangori et al., 2017), decision-making (Fang et al., 2019), judgment skills (Chang et al., 2020), scientific habits of mind (Wiyarsi et al., 2023), and the effect on scientific attitudes (Xiao and Sandoval, 2017), it is seen that the reflections of argumentation (Hacıoğlu and Kartal, 2022), and direct-reflective teaching (Kaya and Güder, 2023), concept cartoons (Atasoy et al., 2022), model-based inquiry approach (Bulduk and Aydoğdu, 2023), community-based topics on attitudes (Kim et al., 2020; Xiao and Sandoval, 2017), and decision-making toward SSIs have been examined (Fang et al., 2019). When the studies on philosophy for children are examined, it is seen that the effect of P4C on questioning and critical thinking skills has been examined (Yurtbakan, 2023; Zulkifli and Hashim, 2020). The fact that the effect of P4C on primary school students' attitudes toward SSIs has not been examined in previous studies makes this study necessary. Thanks to this study, primary school students will be able to find discussion topics suitable for Philosophy for Children. In addition, it is also important to investigate the effectiveness of the Philosophy for Children application, which has been shown to be effective in primary school students' questioning and critical thinking skills, in raising students' awareness of SSIs, which is an important factor in making today's world more livable. SSIs that do not have definite results, develop different perspectives on SSIs with the questioning skills they gain and increase their awareness and sensitivity to SSIs that have benefits and harms on society and the environment. With this importance, in this study, the effect of P4C on 4th-grade primary school students' attitudes toward asking questions and SSIs was examined.

1. Is philosophy for children more effective than traditional reading in the post-test scores of 4th-grade primary school students' attitudes toward SSIs?
2. Is philosophy for children more effective than traditional reading in 4th-grade primary school students' attitudes toward asking questions?

METHODS

Research Design

A quasi-experimental design was used to examine the effect of P4C on students' (primary school fourth grade) attitudes toward asking questions and SSIs. The quasi-experimental design, which is one of the experimental designs used to test the cause-and-effect relationship between independent and dependent variables (Büyüköztürk et al., 2019), is applied after the pre-test and the post-test is applied to determine the effect of the practice on the dependent variable, and thus the cause-and-effect relationship is best explained (Fraenkel and Wallen, 2011). In this context, in this study, after the 4th-grade primary school students' attitudes toward asking questions and their attitudes toward SSIs were determined by pre-test, the philosophy for children practice was applied. After the end of the intervention, the post-test was carried out and the change in students' attitudes toward SSIs and questioning attitudes of P4C was revealed. In addition, since philosophy for children had previously been effective on students' questioning skills, it was necessary to compare its status with traditional reading in questioning skills. In fact, a quasi-experimental design was used to compare the awareness of students who had knowledge about SSIs by reading about SSIs according to the philosophy for children application.

Study Group

Two of the five primary school 4th grades in a primary school affiliated with Derince District in Kocaeli province were selected for the study through convenience sampling. Convenience sampling is one of the purposeful sampling methods that is easy to access for the study group and is used to speed up the study (Ekiz, 2009). To speed up the study, one of the fourth grades of the primary school, which was formed while enrolling in the first grade of primary school, was randomly assigned as the experimental group (EG) and the other as the control group (CG). There were 24 students in the EG and CG.

More than half of the primary school 4th-grade students in the EG liked the mathematics course and one-fourth liked the science course, while one-third of the students in the CG liked the science course (Table 1). Almost half of the students in the EG and two-thirds of the CG had low reading habits. Although only two of the students in the EG preferred to read books about social issues, none of the students in the CG preferred to read books about social issues. In this sense, it can be said that both EG and CG students are not very interested in science and Turkish lessons, have low reading habits, and do not prefer to read books on social issues. Thus, it can be thought that both their sensitivity toward social issues and their questioning skills are low. For the teachers and students in the EG to carry out the philosophy for children practice in a healthy way, the book "Dot" written by Peter H. Reynolds, which emphasizes the importance of the beginning in success, was discussed with the philosophy for children practice under the guidance of the researcher.

The results of the independent t-test carried out to the pre-test scores of the students in the EG and CG students' attitudes toward SSIs and asking questions are presented in Table 2.

According to Table 2, It is seen that the pre-test scores of the students (primary school fourth grade) in the EG and CG in terms of their attitudes toward SSIs and asking questions were equivalent ($p > 0.05$).

Table 1: Student Information

Variable	EG		CG	
	f	%	f	%
Favorite lessons				
Science education	6	12.5	8	16.67
Turkish	-	-	2	4.17
Mathematics	13	27.08	8	16.67
Others	5	10.42	6	12.49
Reading habit				
Low	10	20.83	16	33.33
Medium	8	16.67	7	14.58
High	6	12.50	1	2.09
Preferred genre of reading				
Adventure	19	39.58	19	39.58
Emotional	-	-	2	4.17
Science fiction	3	6.25	2	4.17
Social issues	2	4.17	-	-
Heroism	-	-	1	2.08

EG: Experimental group, CG: Control group

Table 2: Experimental and control group equivalence of attitude toward SSIs and asking questions

Scale	Groups	n	x	d	Levene test		t	p
					F	p		
Attitude toward SSIs	Control	24	0.97	49	2.422	0.13	−1.757	0.09
	Experiment	24	0.20	38				
Question asking attitude	Control	24	0.90	65	0.333	0.57	−1.165	0.25
	Experiment	24	0.12	66				

p<0.05*, SSI: Socioscientific issues

Data Collection Tools

The data were collected with the "Attitudes Toward Asking Questions Scale" developed by Doğan (2018) and the "Children's Attitudes Toward SSIs Scale" developed by Alkış Küçükaydın et al. (2021).

Question asking attitude scale

The scale developed by Doğan (2018) is in a 5-point Likert style ("Never," "Rarely," "Sometimes," "Usually," and "Always") and consists of 23 questions in total. The Cronbach Alpha (α) values of the sub-dimensions of being anxious and being open to asking questions were found to be 0.78 and 0.80, 0.84 for the whole scale, and 0.90 for the study. The root mean square error of approximation (RMSEA) value obtained as a result of the CFA analysis was 0.05, the GFI and AGFI indices were above 0.85, and the CFI and NNFI values were above 0.90, indicating that the scale had a good fit. The KMO coefficient obtained after the exploratory factor analysis was 0.788 (acceptable) and Bartlett's test was p<0.05, therefore the data were valid.

Children's attitudes toward SSIs scale

The scale adapted by Alkış Küçükaydın et al. (2021) consists of 19 items and 6 factors (personal interest, school interest level, positive emotions, anxiety, shared competence, commitment to others). According to CFA; CFI (0.967), IFI (0.967), and GFI (0.931), χ^2/SD (2.51) statistics and RMSEA (0.055) values show excellent fit. α value was found to be 0.941.

Data Collection and Analyzes

The study started with the selection of socio-scientific topics to be discussed with the philosophy for children's practice. While selecting the socio-scientific topics, the 4th-grade units and achievements of the primary school science curriculum were examined. According to the examination, it was stated by one science expert studying in the field of primary school education and two science experts studying in the field of science and mathematics education at the university that the topics of the conscious consumer, the importance of resources, and recycling in the "human and environment" unit were prone to SSIs. The SSI topics to be discussed with the P4C practice are given in Table 2. Then, books and stories were determined for the SSI. While determining the books, the criteria of attracting children's attention, having no difficulty in understanding, not setting a negative example for them (fighting, bad words, etc.), being prone to SSIs, and being suitable for the primary school science curriculum were taken into consideration. The selected books (Table 2) were submitted to two primary reading and writing experts studying in the field of primary school education at the university, one science expert, and the classroom teachers working at the school to be studied for approval.

After the selection of SSIs, books, and stories, attitudes toward asking questions and children's attitudes toward socioscientific topic scales were applied to the students in different lessons in the presence of the researcher as a pre-test (Table 3). After the pre-test was carried out, the stories and books that were determined to be prone to SSIs were discussed with the help of philosophy for children in the EG once a week for 5 weeks, while in the CG, SSIs were read and questions about the story were asked. After the practice, the "Question Asking Attitude Scale" and "Children's Attitudes Toward SSIs Scale" scales were applied to the students as a post-test. The statistical significance between the post-test points of the EG students, whose awareness and question-asking attitudes toward SSIs were tried to be developed through philosophy for children, and the post-test points of the CG students, whose awareness and question-asking attitudes toward SSIs were tried to be developed through traditional reading, was examined by Mann Whitney U test. In addition, the change between the pre- and post-test points of the students in the EG and CG, whose awareness and questioning attitudes toward SSIs were tried to be developed through P4C and traditional reading, was examined with the Wilcoxon Signs Ranked Test.

Implementation

Before starting the practice, the recommendations on what should be followed when doing philosophy for children and the practices of experimental studies with P4C were reviewed (Yurtbakan, 2023; Gatley, 2020; Gorard et al., 2016; Özkan, 2020).

Reading and Discussion on the Text

Socratic method is used.

Reading

While philosophizing for children in the EG, the teacher in the role of a guide read the story or book containing a socioscientific topic to the students in an interactive way.

Questioning

Students were expected to ask open-ended and closed-ended questions about the story to understand the book. The questions produced by the students are written on the board by the guide and the question that is prone to discussion is presented to the students for voting.

Discussion on the text

The question containing the socioscientific topic that receives the most votes by the students is discussed by the students in a democratic environment, within the framework of ethical rules and respect. In places where the discussion is blocked, the counselor should support the students to produce arguments by asking new questions and should identify the contradictions in the middle as in the Socratic method. Then, he/she gives the floor to the willing students. The guide sometimes summarizes to draw attention to the truths in the discussion and to summarize the subject.

Exercises - Discussion Topics - Writing Topics (40 min)

Exercises

Students' questions about the book they have read are answered.

Discussions

In a democratic environment, with ethical rules and respectful behavior, the students discuss the questions about the subject of the story that is related to life. In places where the discussion is blocked, the counselor asks new questions to the students and supports them to produce arguments and should identify the contradictions in the middle as in the Socratic Method.

Writing topics

Writing topics are the parts of the book that serve the philosophical activity the most. Essay samples are read and students are asked to write essays on the socioscientific topic in the story read and the works are exhibited on the board.

In the CG, the story or book used in the EG for philosophizing for children is read to the students in a shared way through traditional reading, and the teacher and students are expected to ask questions to understand the book, and the students are expected to answer them.

Validity and Reliability

The study started with the selection of socioscientific topics in the primary school science curriculum units that had not been taught. Storybooks suitable for SSIs were selected in line with the opinions of academicians who are experts in the field of science and primary school education. A pilot study was conducted for the students in the EG and the teacher to carry out the philosophy for children to practice effectively. Then, the level of asking questions and awareness of the students in the experimental and CGs about SSIs were compared with valid and reliable scales. The SSIs and question-asking attitudes of the groups that were equal in the pre-test were evaluated both within and between groups.

FINDINGS

In this part of the study, the analyzes conducted to determine between the pre- and post-test scores of primary school students whose awareness and questioning attitudes toward SSIs were tried to be developed through P4C (EG) and traditional reading (CG) were included.

The results of the descriptive analyzes obtained from the pre- and post-test of students' awareness and questioning attitudes toward SSIs are exhibited in Table 4.

Table 3: Information on SSIs and books

No	Book title	Author	SSI
1	Seren's seasons	Twinkl yayınları	Climate change
2	Recycling country	Deryem Ermeydan,	Recycling
3	How we can produce more	Yurtbakan, et al., (2021)	Organic agriculture
4	White aircraft says no to global warming	Zeynep Doymuş, Yeliz Sazak	Global warming
5	Soso's compost book	Sima Özkan	Ready food
6	Purple apple story	Morelma Yayıncılık	Genetically modified organic

SSI: Socioscientific issues

Table 4: Results of pre- and post-test descriptive analyzes of students

Scale	Groups	Test	n	Mean	Standard deviation
Attitude toward SSIs	EG	Pre	24	3.13	0.68
		Post	24	3.28	0.58
	CG	Pre	24	2.81	0.80
		Post	24	3.02	0.47
Question asking attitude	EG	Pre	24	4.12	0.66
		Post	24	4.32	0.41
	CG	Pre	24	3.90	0.65
		Post	24	3.89	0.58

EG: Experimental group, CG: Control group

Table 5: Post-test results of students' attitudes toward SSIs and asking questions

Scale	Groups	n	Mean rank	Sum of ranks	U	p
Attitude toward SSIs	EG	24	28.54	685.00	154.00	0.045*
	CG	24	20.46	491.00		
Question asking attitude	EG	24	30.08	722.00	191.00	0.01*
	CG	24	18.92	454.00		

SSI: Socioscientific issues, EG: Experimental group, CG: Control group, *$p < 0.05$

It can be said that both P4C and traditional reading practices were effective in students' attitudes toward SSIs.

While the post-test points of the students in the EG were higher than the pre-test scores, the opposite was the case in the CG. The change in the pre- and post-test points of the students in the EG and CG in terms of their attitudes toward both SSIs and asking questions, both within and between the groups, is shown in Graphic 1 with a line graph.

According to Graphic 1, the post-test points of the students in the EG increased their attitudes toward both SSIs and asking questions compared to their pre-test points. While the post-test points of the students in the CG increased their attitudes toward SSIs compared to their pre- and post-test points of attitudes toward asking questions decreased compared to their pre-test points. When the pre- and post-test points of the EG students' attitudes toward SSIs and asking questions were compared with the pre- and post-test points of the students in the CG, it was seen that the pre- and post-test points of attitudes toward SSIs and asking questions were higher than the pre- and post-test points.

The difference between the post-test points of the students in the EG and CG was analyzed with the Mann–Whitney U test based on the fact that the pre-test points of the students' attitudes toward SSIs and asking questions were equivalent.

It was revealed that the EG students had better attitudes toward SSIs and asking questions ($p < 0.05$) (Table 5). In this context, it can be said that the P4C practice is more effective than the traditional reading practice in the attitudes of primary school students toward asking questions and SSIs.

The graph showing the change between the pre- and post-test points of students' attitudes toward SSIs in both the EG and the CG is presented in Graphic 2.

According to Graphic 2, it was determined that the post-test scores of 14 students in the EG were higher and 10 were lower than the pre-test points of the students in the EG; 12 of the students in the CG were higher and 10 were lower.

The graph showing the change between the pre- and post-test scores of primary school students' attitudes toward asking questions in both the EG and the CG is presented in Graphic 3.

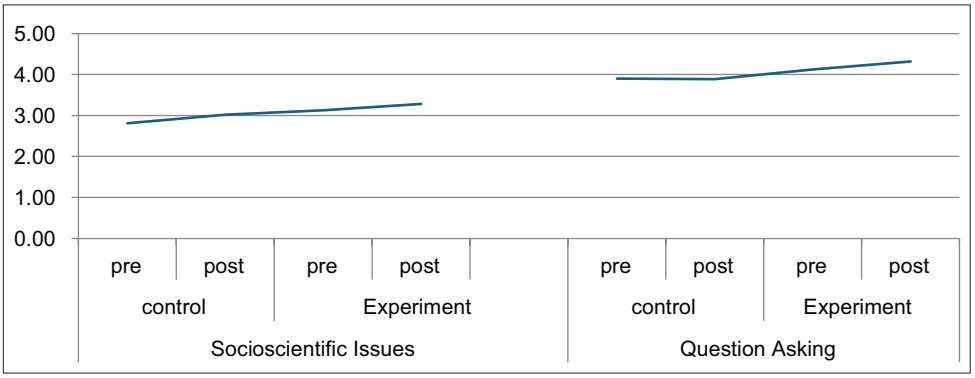
According to Graphic 3, it was determined that the post-test scores of attitude toward asking questions of 13 students in the EG decreased compared to their pre-test scores, and the post-test scores of 11 students decreased compared to their pre-test scores. It is seen that the post-test scores of 12 students in the CG's attitude toward SSIs increased compared to their pre-test scores, and the post-test scores of 10 students decreased compared to their pre-test scores.

The pre- and post-test points of primary school students in the EG and CGs' attitudes toward SSIs and asking questions were analyzed by the Wilcoxon signed-rank test.

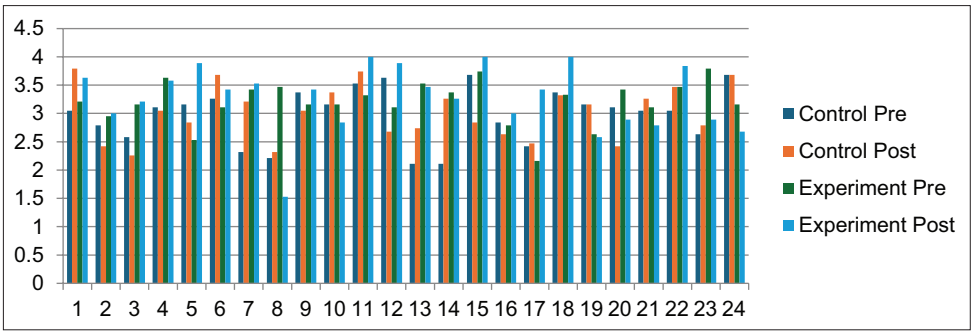
According to Table 6, no change was observed between the pre- and post-test scores of primary school students in the EG and CGs in terms of their attitudes toward SSIs and asking questions ($p > 0.05$). In this sense, it can be said that although philosophy and traditional reading practices for children increase the attitudes of most primary school students toward SSIs, they do not increase them in a statistical sense. It can be said that although philosophy and traditional reading practices for children increase the attitudes toward asking questions in half or nearly half of the primary school 4th-grade students, they do not increase them statistically.

DISCUSSION

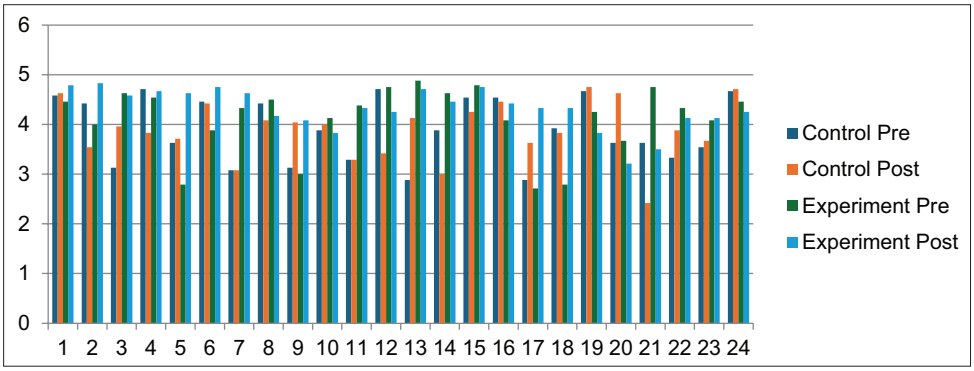
At the end of the study, it was revealed that both the P4C practice (EG) and the traditional reading practice (CG) increased the primary school 4th-grade students' attitudes toward SSIs and asking questions, but this increase was not statistically significant. However, it was determined that the P4C practice created significance in the attitudes of primary school students toward SSIs and asking questions compared to the traditional reading practice. It has been determined that students at different education levels (secondary school, university) have positive attitudes toward SSIs (Erkol and Gül, 2020; Hastürk and Ökkeşoğulları, 2021). Stenseth et al. (2016) found in their study that the level of knowledge students have about SSIs is inversely proportional to their attitudes toward SSIs. In other words, he argues that if the student's level of knowledge about the socioscientific subject is low, he or she has a more positive attitude toward the SSIs. Kim et al. (2020)



Graphic 1: Attitude toward socioscientific issues and asking questions



Graphic 2: Awareness attitude toward socioscientific issues



Graphic 3: Attitude toward asking questions

Table 6: Students' attitudes toward SSIs and asking questions pre- and post-test scores

Scale	Group	Pre- and post-test	n	Mean rank	Sum of ranks	z	p
Attitude toward SSIs	EG	Negative ranks	10	11.75	117.50	−0.930	0.35
		Positive ranks	14	13.04	182.50		
		Tie	0				
	CG	Negative ranks	10	11.45	114.50	−0.390	0.70
		Positive ranks	12	11.54	138.50		
		Tie	2				
Question asking attitude	EG	Negative ranks	13	10.00	130.00	−0.572	0.57
		Positive ranks	11	15.45	170.00		
		Tie	0				
	CG	Negative ranks	10	12.40	124.00	−0.081	0.94
		Positive ranks	12	10.75	129.00		
		Tie	2				

SSI: Socioscientific issues, EG: Experimental group, CG: Control group

and Wiyarsi et al. (2023) concluded that community-based or local SSIs improve attitudes toward SSIs and scientific thinking habits. In this sense, the fact that students do not have enough information about the SSIs in the region they live in may support them to be more sensitive to SSIs. The reason for this may be that if there is negativity regarding SSIs in the region where students live, they will be the first to be affected by this situation. Therefore, students' attitudes and awareness toward SSIs need to be increased. Philosophy for children is a student-centered approach. Compared to traditional reading, students take an active role in the practice of philosophy for children and have the opportunity to determine the questions they will discuss from the questions they generate about a topic. With the Philosophy for children practice, students can generate many questions about a topic. Thanks to the many questions generated, students can interact with each other and find the opportunity to discuss among themselves by determining the question that is prone to discussion, and during the discussion, they can exhibit the behavior of defending the opposite as well as agreeing with each other's ideas. The fact that SSIs have the characteristics of facilitating human life and harming human health may have been effective in increasing students' awareness of SSIs by enabling them to discuss the pros and cons of SSIs in depth with the philosophy for children's practice. It was also revealed that argumentation-based learning increased students' attitudes toward SSIS (Hacıoğlu and Kartal,

2022). Both the practice of philosophy for children and the fact that argumentation-based learning gives students the opportunity to question SSIs that have both benefits and harms to society may have been effective in increasing students' attitudes toward SSIs. It is seen that practices with an inquiry approach also support students' logical thinking on SSIs (Bulduk and Aydoğdu, 2023). In fact, studies show that presenting socioscientific subjects with different characteristics and content to students with different methods and techniques such as concept cartoons (Atasoy et al., 2022) and direct teaching (Kaya and Güder, 2023) improves students' attitudes toward science (Xiao and Sandoval, 2017), decision-making skills (Fang et al., 2019), and reasoning skills (Wiyarsi and Çalik, 2019).

In the study, it was determined that the practice of P4C increased the attitudes of primary school students toward asking questions compared to traditional reading. The presence of open-ended and closed-ended question types based on understanding the book, based on imagination, based on reality and based on questioning in the philosophy for children practice may have increased the type and number of questions that students would produce. Students who had the experience of producing different types of questions may have improved their attitudes toward asking questions. Other studies have also found that P4C improves students' questioning skills (Karadağ, 2023; Özcan et al., 2023). In philosophy for children, students have the opportunity to produce original answers and arguments, become aware of their own thinking processes, and constantly organize their thoughts (Trickey and Topping, 2004). It is necessary to give problem-based topics based on scientific foundations that will enable students to produce arguments and refute the arguments produced. In this sense, SSIs that enable students to discuss the relationship between benefits and harms in a scientific framework, as well as scientific foundations, may have been effective in the improvement of students' attitudes toward asking questions. However, the teacher's lack of sufficient knowledge on SSIs that require deep science knowledge and his inability to use strategies that will raise questions may affect students' active participation in the process (Bossér, 2023). In the study, the fact that the teacher who carried out the P4C practice was a classroom teacher may have caused the students to experience inadequacy in supporting question-generation strategies about science-based SSIs. As a result, although it created an increase in asking questions and attitudes toward SSIs, this increase could not create a significant level. In line with the results obtained from the results of the research, suggestions for both practice and future research are presented.

Suggestions

1. Conducting the philosophy for children practice by selecting local topics in the curriculum rather than all SSIs in the units in the primary school science curriculum may be more effective in increasing students' awareness of SSIs
2. It may be more effective in the development of students' attitudes toward asking questions if the teacher, who is the guide in the philosophy for children practice, models students in generating open and closed-ended questions based on understanding, questioning, reality, and imagination
3. Having a science teacher carry out the philosophy practice for children on science-based SSIs can contribute to students developing different questions about SSIs
4. To improve primary school students' awareness of SSIs, student-centered methods such as P4C can be used instead of traditional methods in science classes
5. It can be associated with different disciplines such as science in developing primary school students' questioning skills, which is one of the aims of Turkish lessons
6. Research can be conducted to determine the effect of P4C on the SSI and question-asking attitudes of students studying at different educational levels.

Limitations

It is a limitation of the study that the teacher who carries out philosophy practice for children on science-based SSIs is a primary school teacher. In addition, it is a limitation that the study only studied the SSIs of climate change, recycling, organic agriculture, global warming, and ready-made food GMOs with primary school students.

CONCLUSION

The development of primary school students' attitudes towards asking questions is supported by SSIs that allow them to discuss the relationship between benefit and harm in a scientific framework as well as scientific foundations through the philosophy for children practice.

REFERENCES

Akkocaoğlu Çayır, N. (2023). The views of teachers on philosophy for children practices: Problems and solutions. *Kaygı. Bursa Uludağ University Faculty of Arts and Sciences Journal of Philosophy*, 22(3), 302-351.

Akkocaoğlu, Ç.N. (2015). *A Qualitative Study on Education of Philosophy for Children.* (Unpublished doctoral thesis). Hacettepe University.

Al, S. (2015). *Pre-servıce Science Teachers' Perceptions of Socioscientific Issues: Global Warming As a Case.* (Unpublished master's thesis). Ankara: Middle East Technical University.

Albe, V. (2008). Students' positions and considerations of scientific evidence about a controversial socioscientific issue. *Science and Education*, 17(8-9), 805-827.

Alkış Küçükaydın, M. (2020). The investigation of the relationship between the attitude towards socioscientific issues and inquıry skills of primary teacher candidates. *Milli Eğitim Dergisi [Journal of National Education)*, 49(225), 181-200.

Alkış Küçükaydın, M., Gökbulut, Y., & Şahinpınar, D. (2021). The study of validity and reliability of pupils' attitudes towards socioscientific ıssues scale. *International Journal of Society Research*, 18(41), 4930-4951.

Atasoy, Ş., Tekbıyık, A., Çalık, M., & Yılmaz-Tüzün, Ö. (2022). Development of argumentation based concept cartoons for socioscientific ıssues: A case of science and art centers. *Education and Science*, 47(211), 323-367.

Avcı, F. (2023). Teachers' views on the philosophy for children (P4c) approach and its facilitator roles. *Educational Academic Research*, 48, 1-13.

Belcastro, S.M. (2017). Ask questions to encourage questions asked. *Problems, Resources, and Issues in Mathematics Undergraduate Studies*, 27(2), 171-178.

Birnbacher, D., & Ladwig, B. (2006). *Information Philosophie*. Auburn, CA: Claudia Moser.

Boogeholz, S., & Barkmann, J. (2005). Rational choice and beyond: Handlungsorientierende Kompetenzen für den Umgang mit faktischer und ethischer Komplexität. In: *Lehr-und Lernforschung in der Biologiedidaktik*. Vol. 2. Innsbruck: StudienVerlag, pp. 211-224.

Bossér, U. (2023). Transformation of school science practices to promote functional scientific literacy. *Research in Science Education,* 54, 265-281.

Brualdi, A.C. (1998). Classroom questions. *Practical Assessment, Research and Evaluation*, 6(6), 1-3.

Bulduk, Ö., & Aydoğdu, C. (2023). The effect of modeling on students' logical thinking skills in socioscientific ıssues teaching. *The Journal of Buca Faculty of Education*, 57, 1177-1209.

Büyüköztürk, Ş., Çakmak, E., Akgün, Ö., Karadeniz, Ş., & Demirel, F. (2019). *Eğitimde Bilimsel Araştırma Yöntemleri* [*Scientific Research Methods in Education*]. Ankara: Pegem Academy.

Çakır Yıldırım, B. & Öztürk N. (2021). Bilimsel okuryazarlık [Scientific literacy]. In K. Bilican & B. Şenler (Ed.) *İlkokulda fen öğretimi* [*Science teaching in primary school]*. Vizetek Publishing, (pp. 1-16)

Chang, H.Y., Liang, J.C., & Tsai, C.C. (2020). Students' context-specific epistemic justifications, prior knowledge, engagement, and socioscientific reasoning in a mobile augmented reality learning environment. *Journal of Science and Educational Technology*, 29, 399-408.

Chang, S.N., & Chiu, M.H. (2008). Lakatos' scientific research programmes as a framework for analysing informal argumentation about socio-scientific issues. *International Journal of Science Education,* 30(13), 1753-1773.

Chen, L., & Xiao, S. (2021). Perceptions, challenges and coping strategies of science teachers in teaching socioscientific issues: A systematic review. *Educational Research Review*, 32, 100377.

Chin, C. (2006). Classroom interaction in science: Teacher questioning and feedback to students' responses. *International Journal of Science Education*, 28(11), 1315-1346.

Dawson, V.M., & Venville, G. (2010). Teaching strategies for developing students' argumentation skills about socioscientific issues in high school genetics. *Research in Science Education*, 40, 133-148.

Demiral, Ü., & Çepni, S. (2018). Fen bilgisi öğretmen adaylarının sosyobilimsel bir konudaki argümantasyon becerilerinin incelenmesi [Investigation of pre-service science teachers' argumentation skills in a socioscientific subject]. *Kırşehir Eğitim Fakültesi Dergisi* [*Journal of Kırşehir Faculty of Education*], 19(1), 734-760.

Doğan, F. (2018). *Investigation of the Primary School 4th Grade Students' Attitudes towards Asking Questions in Tems of Teachers' and Students' Perception*. (Unpublished master's thesis). Yıldız Teknik University.

Dori, Y.J., Tal, R.T., & Tsaushu, M. (2003). Teaching biotechnology through case studies-can we improve higher order thinking skills of nonscience majors? *Science Education*, 87, 767-793.

Eastwood, J.L., Sadler, T.D., Zeidler, D.L., Lewis, A., Amiri, L., & Applebaum, S. (2012). Contextualizing nature of science instruction in socioscientific issues. *International Journal of Science Education*, 34(15), 2289-2315.

Ekiz, D. (2009). *Bilimsel Araştırma Yöntemleri* [*Scientific Research Methods*]. Ankara: Ani Publishing.

Erkol, M., & Gül, Ş. (2020). Prospective science teachers' attitudes towards socioscientific issues. *PESA International Journal of Social Studies*, 6(1), 9-21.

Erkuş, B., & Kılıç, D. (2015). Classroom teachers' questionning strategies and the problems they encounter. *Manas Journal of Social Studies*, 4(5), 230-243.

Fang, S.C., Hsu, Y.S., & Lin, S.S. (2019). Conceptualizing socioscientific decision making from a review of research in science education. *International Journal of Science and Mathematics Education*, 17, 427-448.

Fisher, R. (2008). Philosophical intelligence: What is it and how do we develop it? *Thinking: The Journal of Philosophy for Children*, 19(1), 12-19.

Fraenkel, J.R., & Wallen, N.E. (2011). *How to Design and Evaluate Research in Education*. 8th ed. United States: McGraw-Hill Higher Education.

Friedrichsen, P.J., Ke, L., Sadler, T.D., & Zangori, L. (2021). Enacting co-designed socio-scientific issues-based curriculum units: A case of secondary science teacher learning. *Journal of Science Teacher Education*, 32(1), 85-106.

Garcia, G.E., & Pearson, P.D. (1990). *Modifying Reading Instruction to Maximize Its Effectiveness for All Students* (*Technical Report No. 489*). Champaign, IL: University of Illinois, Centre for the Study of Reading.

Gatley, J. (2020). Can the New Welsh Curriculum achieve its purposes? *The Curriculum Journal*, 31(2), 202-214.

Gorard, S.N., Siddique, B., & See, H. (2016). Can 'philosophy for children' improve primary school attainment? *Journal of Philosophy of Education*, 51(1), 5-22.

Gürbüzkol, R., & Bakırcı, H. (2020). Identifying science teachers' attitudes and opinions about socio-scientific ıssues. *Van YYU Journal of Education Faculty*, 17(1), 870-893.

Hacıoğlu, C.H., & Kartal, T. (2022). The effect of argumentation-based teaching approach on student attitudes towards socioscientific ıssues. *Fen Bilimleri Öğretimi Dergisi* [*Journal of Science Teaching*], 10(1), 64-83.

Hancock, T.S., Friedrichsen, P.J., Kinslow, A.T., & Sadler, T.D. (2019). Selecting socio-scientific issues for teaching. *Science and Education*, 28, 639-667.

Hastürk, H.G., & Ökkeşoğulları, E. (2021). Examination of secondary school students' attitudes towards socioscientific issues. *Education Quarterly Reviews*, 4(2), 513-525.

Jones, M.G. (1990). T-zone, target students and science classroom interactions. *Journal for Research in Science Teaching*, 27(7), 651-660.

Karadağ, F. (2023). The effect of philosophy for children (P4C) curriculum on formulating question skills of children with special learning disabilities. *Anadolu University Journal of Education Faculty* (*AUJEF*), 7(3), 570-587.

Kaya, Z., & Güder, O. (2023). The effect of explicit-reflective ınstruction approach on fourth grade students' socioscientific decisionmaking skills. *Millî Eğitim Dergisi* [*Journal of National Education*], 52, 737-762.

Kennedy, D. (2015). Practicing philosophy of childhood: Teaching in the (r) evolutionary mode. *Journal of Philosophy in Schools*, 2(1), 1-14.

Khishfe, R. (2012). Nature of science and decision-making. *International Journal of Science Education*, 34(1), 67-100.

Kılınç, A., Kartal, T., Eroğlu, B., Demiral, Ü., Afacan, Ö., Polat, D., Demirci Güler, M.P., & Görgülü, Ö. (2013). Preservice science teachers' efficacy regarding a socioscientific issue: A belief system approach. *Research in Science Education*, 43(6), 2455-2475.

Kim, G., Ko, Y., & Lee, H. (2020). The effects of community-based socioscientific issues program (SSI-COMM) on promoting students' sense of place and character as citizens. *International Journal of Science and Mathematics Education*, 1(8), 399-418.

Klaver, L.T., & Walma van der Molen, J.H. (2021). Measuring pupils' attitudes towards socioscientific issues. *Science and Education*, 30, 317-344.

Kodaz Öcal, N., & Aybek, B. (2023). Problems experienced by teachers in philosophy for children (p4c) trainning. *Kaygı. Bursa Uludağ University Faculty of Arts and Sciences Journal of Philosophy*, 22(3), 258-301.

Kolsto, S.D. (2006). Patterns in students' argumentation confronted with a risk-focused socio-scientific issue. *International Journal of Science Education*, 28(14), 1689-1716.

Kumari, P., Arora, S.K., & Tiwari, S. (2015). Impact of inquiry-based teaching model on academic achievements in social science subject of 9th class student of secondary schools located in urban area. *International Journal of Recent Research Aspects*, 2(4), 154-158.

Lam, C.M. (2021). The impact of philosophy for children on teachers' professional development. *Teachers and Teaching*, 27(7), 642-655.

Lee, H., Chang, H., Choi, K., Kim, S.W., & Zeidler, D.L. (2012). Developing character and values for global citizens: Analysis of pre-service science teachers' moral reasoning on socioscientific issues. *International Journal of Science Education*, 34(6), 925-953.

Leslie, I. (2015). In: Topakbaş, C.E. (Trans.), *Merak* [*Curious*]. İstanbul: NTV Publishing.

Levinson, S.C. (2006). On the human "Interaction Engine". In: Enfield, N.J., & Levinson, S.C. (Eds.), *Roots of Human Sociality: Culture, Cognition and Interaction*. Oxford: Berg, pp. 39-69.

Lewis, J., & Leach, J. (2006). Discussion of socio-scientific issues: The role of science knowledge. *International Journal of Science Education*, 28(11), 1267-1287.

Minken, Z., Macalag, A., Clarke, A., Marco-Bujosa, L., & Rulli, C. (2021). Development of teachers' pedagogical content knowledge during lesson planning of socioscientific issues. *International Journal of Technology in Education*, 4(2), 113-165.

Mohr Lone, J. (2017). In: Arıkan, G. (Trans.), *Filozof Çocuk* [*The Philosopher Child*]. İstanbul: Sola Publishing.

Motherway, G. (2022). A democratic school: Teacher reconciliation, child-centred dialogue and emergent democracy. *Journal of Philosophy of Education*, 56, 998-1013.

Murris, K.S., & Thompson, R. (2016). Drawings as imaginative expressions of philosophical ideas in a Grade 2 South African literacy classroom. *Reading and Writing - Journal of the Reading Association of South Africa*, 7(2), a127.

Osborne, J., Collins, S., Ratcliffe, M., Millar, R., & Duschl, R. (2003). What "ideas-about-science" should be taught in school science? A delphi study of the expert community. *Journal of Research in Science Teaching*, 40, 692-720.

Özcan, S., Sallabaş, M.E., & Akgül, S. (2023). The effect of P4C-based Turkish teaching on receptive language skills and questioning skills. *Millî Eğitim Dergisi* [*Journal of National Education*], 52(240), 2957-2976.

Özkan, B. (2020). Why is philosophy important for children? *National Journal of Education Academy,* 4(1), 49-61.

Pedrosa de Jesus H., Leite, S., & Watss, M. (2012). *Auto-reflection Through Classroom Interaction: The Role of Pupil's Individual Differences.* ELSIN. Available from: https://cidtff.web.ua.pt/producao/helena_pedrosa/pedrosaformatted.pdf

Quinn, J. A., Munoz, F. M., Gonik, B., Frau, L., Cutland, C., Mallett-Moore, T., *et al.* (2016). Preterm birth: Case definition & guidelines for data collection, analysis, and presentation of immunisation safety data. *Vaccine*, 34(49), 6047-6056.

Rudsberg, K., Öhman, J., & Östman, L. (2013). Analyzing students' learning in classroom discussions about socioscientific issues. *Science Education*, 97(4), 594-620.

Sadler, T.D. (2004). Informal reasoning regarding socioscientific issues: A critical review of research. *Journal of Research in Science Teaching*, 41(5), 513-536.

Sadler, T.D. (Ed.), (2011). Situating socio-scientific issues in classrooms as a means of achieving goals of science education. In: *Socio-scientific Issues in the Classroom: Teaching, Learning, and Research*. Berlin: Springer, pp. 1-9.

Sadler, T.D., & Zeidler, D.L. (2004). The morality of socioscientific issues: Construal and resolution of genetic engineering dilemmas. *Science Education*, 88, 4-27.

Sadler, T.D., Romine, W.L., & Topçu, M.S. (2016). Learning science content through socio-scientific issues-based instruction: A multi-level assessment study. *International Journal of Science Education*, 38(10), 1622-1635.

Saylık, N., Memduhoğlu, H., & Yayla, A. (2017). A trial of a new teaching technique for developing critical and interrogative thinking capabilities of students in elementary education: Question balls technique. *Electronic Journal of Social Sciences*, 16(61), 519-533.

Stenseth, T., Bråten, I., & Strømsø, H.I. (2016). Investigating interest and knowledge as predictors of students' attitudes towards socio-scientific issues. *Learning and Individual Differences*, 47, 274-280.

Tidemand, S., & Nielsen, J.A. (2017). The role of socioscientific issues in biology teaching: From the perspective of teachers. *International Journal of Science Education,* 39(1), 44-61.

Topçu, M.S., & Atabey, N. (2017). The effect of socioscientific issues based field trips on elementary school students' argumentation quality. *Bartın University Journal of Faculty of Education*, 6(1), 68-84.

Trickey, S., & Topping, K.J. (2004). 'Philosophy for children': A systematic review. *Research Papers in Education*, 19(3), 365-380.

Vansieleghem, N. (2005). Philosophy for children as the wind of thinking. *Journal of Philosophy of Education*, 29(1), 19-35.

Vishal Kumar, V., Kumar Choudhary, S., & Singh, R. (2024). Environmental socio-scientific issues as contexts in developing scientific literacy in science education: A systematic literature review. *Social Sciences and Humanities Open*, 9, 100765.

Wasserman, S. (1991). Teaching strategies: The art of the questions. *Childhood Education*, 67(4), 257-259.

Wiyarsi, A., & Çalik, M. (2019). Revisiting the scientific habits of mind scale for socio-scientific issues in the Indonesian context. *International Journal of Science Education,* 41(17), 2430-2447.

Wiyarsi, A., Çalik, M., Priyambodo, E., & Dina, D. (2023). Indonesian prospective teachers' scientific habits of mind: A cross-grade study in the context of local and global socio-scientific issues. *Science and Education* (*Dordr*), 33, 1257-1283.

Worley, P. (2019). *Felsefe Makinesi. Bir Yol Haritası: Çocuklar İçin Felsefe* (*P4C*) *Nasıl Yapılır*? [*Philosophy Machine. A Roadmap: How to do Philosophy for Children* (*P4C*)*?*]. Istanbul: Paraşüt Book.

Xiao, S., & Sandoval, W.A. (2017). Associations between attitudes towards science and children's evaluation of information about socioscientific issues. *Science and Education*, 26, 247-269.

Xu, A. (2022) The importance of philosophy for children . *International Journal of New Developments in Education,* 4(7), 21-34. https://doi.org/10.25236/IJNDE.2022.040705.

Yahaya, J.M., Ahmad Nurulazam, A., & Mageswary Karpudewan, M. (2016). College students' attitudes towards sexually themed science content: A socioscientific issues approach to resolution*. International Journal of Science Education*, 38(7), 1174-1196.

Yenisoy Şahin E. (2023). Justification for "philosophy for children" through feminist epistemology. *Bursa Uludağ University Faculty of Arts and Sciences Journal of Philosophy*, 22(3), 113-133.

Yurtbakan, E., Çalık, M., & Güler, T. (2021). Investigating fourth grade students' conceptual growth of the 'organic and nonorganic foods' subject: A case of common knowledge construction model. *Hacettepe University Journal of Education*, 36(3), 544-561.

Yurtbakan, E. (2023). The effect of phılosophy for chıldren made wıth chıldren's pıcture books ın the development of crıtıcal thınkıng skılls and values education of gıfted prımary school students. *Trakya Journal of Education*, 13(2), 856-868.

Zangori, L., Peel, A., Kinslow, A., Friedrichsen, P., & Sadler, T.D. (2017). Student development of modelbased reasoning about carbon cycling and climate change in a socio-scientific issues unit. *Journal of Research in Science Teaching*, 54(10), 1249-1273.

Zeidler, D.L. (2014). Socioscientific issues as a curriculum emphasis: Theory, research and practice. In: Abell, S.K., & Lederman, N.G. (Eds.), *Handbook of Research on Science Education.* United Kingdom: Routledge, pp. 697-726.

Zeidler, D.L., Herman, B.C., & Sadler, T.D. (2019). New directions in socioscientific issues research. *Disciplinary and Interdisciplinary Science Education Research*, 1(1), 11.

Zeidler, D.L., Sadler, T.D., Applebaum, S., & Callahan, B.E. (2008). Advancing reflective judgment through Socioscientific Issues. *Journal of Research in Science Teaching*, 46(1), 74-101.

Zulkifli, H., & Hashim, R. (2020). Philosophy for children (P4C) in improving critical thinking in a secondary moral education class. *International Journal of Learning, Teaching and Educational Research*, 19(2), 29-45.