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Socioscientific Issues-Based Popular Science Readings with Prospective Classroom Teachers

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Abstract

The aim of this study is to determine the effect of socioscientific issues-based popular science readings on critical thinking skills and reading habits-related attitudes of prospective classroom teachers. This quantitative research employed the one-group pretest-posttest research design, which is recognized as a weak experimental design. The research was conducted with 15 volunteered prospective classroom teachers. The "Critical Thinking Skills Questionnaire" and "Attitude Scale towards Reading Habits" were applied as a pre-test and post-test to measure variations in participants' critical thinking skills and reading habits. During the 10-week experimental process, articles about socioscientific issues from a popular Turkish science magazine (Science and Technique [Bilim ve Teknik]) were read with prospective classroom teachers. As a result, it was found that socioscientific issues-based popular science readings led to a statistically significant ($p<0.05$) increase in participants' mean scores from both post-test scales compared to their mean scores from pre-test scales. Also, the effect size ($\acute{\eta}^2$) of the difference between pre-test and post-test mean scores was found to be a large effect size. Socioscientific issues-based activities take the learning process to another dimension and can serve as a tool for students to gain a perspective towards the world and science and to question and interpret real-life situations. It is thought that such processes, which can be designed using various activities, can contribute to the professional development of prospective teachers. Using such activities in primary schools can make the teaching process more fun and increase students' interest and engagement in classes.

INTRODUCTION

With the science curricula published in 2013 and 2018, the Turkish Ministry of National Education (MoNE) defined the desired student profile as individuals who can research the source of information and question and discuss events and situations. To develop these expected skills, students need to be aware of the effects of developing technology on everyday life and being able to relate science subjects to daily living skills (scientific literacy). The skills that are desired to be developed by students are included in curricula as learning outcomes (Türksever et al., 2020). Real-life problems can be a tool in helping students relate what they have learned in science classes to the real world. Real-life problems are considered socioscientific issues, and they encourage students to establish and discuss relationships between daily life and science problems (Lin & Mintzes, 2010). Socioscientific issues are complex, socially relevant real-world problems, which are informed by science, and also contain ethical and other dimensions (Sadler et al., 2016). Socioscientific issues have long

been advocated as a context for students in order to promote scientific literacy and thus raise responsible citizens who can use science in their daily lives (Ke et al., 2020). In socioscientific issues, certain dilemmas, ethics, moral principles, and societal concerns are discussed in the context of sciences. When making decisions about socioscientific issues, individuals take into account different dimensions such as ethical, legal, psychological, and medical dimensions (Demiral & Türkmenoğlu, 2018). Activities based on socioscientific issues can provide rich content for students to gain a perspective on the world and science, and question and interpret real-world situations. This is because socioscientific issues-based learning provides students with meaningful contexts enabling them to contemplate how they might relate science to their own lives and communities. Thus, it guides students to evaluate the moral and ethical consequences of complex social problems in real life (Ke et al., 2020).

Having knowledge about socioscientific issues, the student can interpret, discuss, research, and critically think about events and situations, and take into account environmental, economic, and social dimensions in their decisions. The dilemma students face when discussing socioscientific issues and when making decisions about them can provide them with an opportunity to think critically about situations (Chang-Rundgren & Rundgren, 2010; Zeidler & Nichols 2009). Indeed, critical thinking helps individuals observe events and situations better and make more accurate inferences from their observations. Thus, they can test claims put forward and recognize contradictions and inconsistencies (Deniz, 2009). Halpern (2002) describes critical thinking as purposeful, reasoned, and goal-directed thinking that is involved in solving problems, formulating inferences, calculating likelihoods, and making decisions. From this point of view, in order to help students develop critical thinking skills, it is first necessary to create learning settings that promote critical thinking (Tok, 2008). This is only possible through activities to be carried out in democratic classroom environments where students can acquire many skills from an early age (Kaya, 2010). Such classroom environments should also be focused on key concepts such as reflective thinking, focusing on the subject, observing, questioning, judging, making inferences, using information, analyzing, evaluating, reasoning, problem-solving, assessing solutions, and empathizing (Akar, 2007). Thus, activities promoting critical thinking skills can serve as a bridge in achieving permanent and effective learning. Moreover, to achieve this, various activities should be included in formal and informal learning environments.

Today, articles about scientific developments, technological inventions, and natural events attract attention and are considered important in preparing children for the future (Turan, Kurt & Arslan, 2016). Behaviors desired to be developed by students are not only acquired through formal education activities but also through various stimuli. One of these stimuli is the media sources, which have a high potential to create public opinion and raise awareness among people (Doğu-Gültekin & Ünlü, 2020). Absorbing articles that arouse curiosity, in which technological inventions, scientific discoveries, or natural events are described, are frequently used by media sources (Demirel, 2011). Such issues, which are followed with interest by people, have been called popular science (Eroğlu & Sağlam, 2020). Newspapers, magazines, TV programs, and documentaries make publications on popular science to ensure that people could better follow scientific developments and to convey them to a broader range of audiences (Özsevgeç, Eroğlu & Öztürk-Köroğlu, 2017). Publications on popular science can highlight different topics such as the biographies of scientists, the emergence of scientific developments and interesting events of the period, the place of today's scientific developments in our lives and their effects, and funny experiments (Eroğlu & Sağlam, 2020). Such topics, which are complex by nature, and the language of science, in which technical terms are used frequently, can be easily understood by ordinary people with popular science

applications. Thus, a broader range of audiences becomes able to follow more closely current developments and discoveries in science and technology, as well as recent scientific claims (Özsevgeç et al., 2017).

Chowdhury and Halder (2016) argued that the traditional sources of educational guidance were no longer adequate to meet learners' fast-changing educational demands. The authors also suggested that informal sources like media, especially daily newspapers, could be used for a wider spread of education. Socioscientific issues are open-ended, unresolved problems comprising dilemmas (Levinson, 2006), and they are current and interesting because they can be evaluated by different, contradictory thinking structures. These issues can convey information to the public in various ways. Popular science publications, which are the most important organs of our daily life, also contribute to bringing these issues to the attention of people (Öztürk & Erabdan, 2018). The relationship among socioscientific issues, science, media, and people has been tried to be described in the following figure:

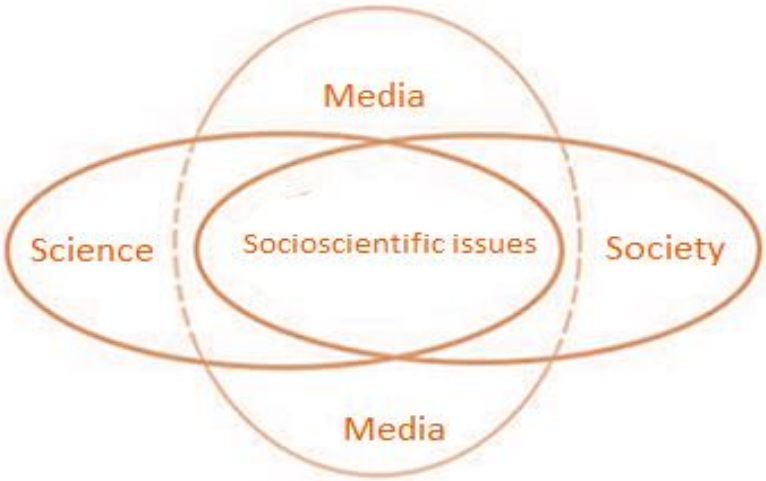

Figure 1. The relationship among socioscientific issues, science, media, and people (Öztürk et al., 2017)

Many socioscientific issues at the center of science and society, such as gene therapy, cloning, in vitro fertilization, genetically modified organisms (GMOs), nuclear energy, ozone destruction, fossil fuel use, are frequently discussed in the media, and as a result, in popular science publications.

For science to affect people positively, it must spread to a wider range of audiences and become a part of common thought (Karakuş & Ergün, 2016). In this regard, popular science publications are considered important in promoting this spread by being used effectively in teaching-learning processes (Çakmakçı, 2017). Science-based reading activities can both increase the popularity of science among people and bring it to larger audiences outside of school (Romance & Vitale, 1992). Thus, one's curiosity, interest and motivation for learning and research by reading will increase. One of the factors that motivate a person towards reading is their attitudes and curiosity about reading habits (Özbay, Bağcı & Uyar, 2008). Reading activities help students to visualize the learned concepts in their minds and provide them with the opportunity to establish a connection between their prior knowledge and newly learned knowledge (Güngör, 2009). It has also been emphasized that increasing academic reading experiences positively affect critical thinking skills (Büyükkanber & Makaracı, 2015). In addition, perceiving reading as an entertaining activity makes it an important tool for

learning innovations and following current developments (Yıldız, Ketenoğlu-Kayabaşı, Ayaz & Aklar, 2017). Supporting the reading experience with different tools comes into prominence in gaining reading habits, and this increases the desire to reach information by triggering curiosity. Students can take an interest in socioscientific issues and use discussion processes with their prior knowledge about a subject (Sandoval & Milwood, 2005; Khishfe, 2012). It is obvious that teachers and prospective teachers who are preparing for the profession are also exemplary models for the next generation and society. Therefore, it is important for them to gain reading habits with different reading experiences, question what they read, look critically and develop their decision-making skills. Socioscientific issue-based readings can be seen as valuable in terms of this experience.

Taking these as a starting point, the researcher presented a different reading experience to prospective teachers. The researcher designed the socioscientific issue-based article reading as an activity process, using a popular science magazine. Throughout the experimental process, the researcher also provided an opportunity for prospective teachers to question and interpret real-world situations. These activities were carried out with prospective classroom teachers, and it was aimed to determine the effect of the process on their critical thinking skills and reading habits. The reason why prospective classroom teachers were included in the study group is that they are expected to be the first persons who will raise awareness in children about socioscientific issues through courses such as social studies and science. Furthermore, the researcher deemed it important to include them in an experimental process, including student-centered activities which they can carry out with children in their future professional lives. Considering the relevant literature studies were examined, no study was found, especially in the sample of prospective classroom teachers, that designed socioscientific issues as a tool in the form of popular science readings, and thus measured critical thinking skills and reading habits. In this regard, the present study is expected to contribute to the literature by offering a teaching activity that teachers can use in classrooms. In this context, the aim of this study is to determine the effect of socioscientific issues-based popular science readings on critical thinking skills and reading habits-related attitudes of prospective classroom teachers.

Hence, the main problem statement was posed as follows: “Do socioscientific issues-based popular science readings affect critical thinking skills and reading habits-related attitudes of prospective classroom teachers?” The sub-problems posed based on this problem statement are listed below:

1. Is there a significant difference between prospective classroom teachers’ mean scores from the critical thinking skills before and after socioscientific issues-based popular science reading activities?
   Hypothesis (H_0): There is no significant difference between prospective classroom teachers’ mean scores from the critical thinking skills before and after socioscientific issues-based popular science reading activities.

2. Is there a significant difference between prospective classroom teachers’ mean scores from the reading habits-related attitudes before and after socioscientific issues-based popular science reading activities?
   Hypothesis (H_0): There is no significant difference between prospective classroom teachers’ mean scores from the reading habits-related attitudes before and after socioscientific issues-based popular science reading activities.

METHOD

Research Model

This quantitative research employed the experimental design. Initially, the researcher wanted to form an experimental and a control group; however, a control group could not be formed due to the low number of prospective classroom teachers who wanted to participate in the study. Thus, the study used the one-group pretest-posttest research design, which is considered a weak experimental design. In this design, the effect of the experimental process is tested on a single group. Measurements related to dependent variables are performed by using the same measurement tools on the same participants as pre-tests and post-tests before and after the experimental process (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2012; Creswell, 2017). The experimental process is presented in Figure 2:

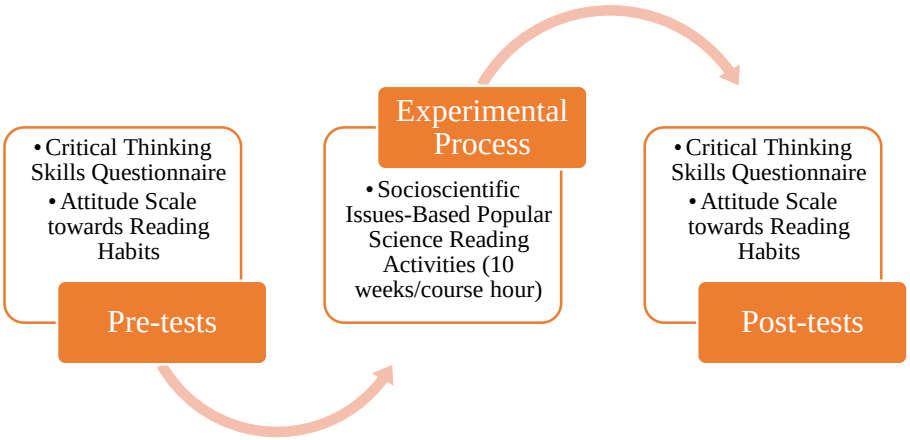

Figure 2. One-group pre-test / post-test research design

As seen in Figure 2, the Critical Thinking Skills Questionnaire and Attitude Scale towards Reading Habits were applied as a pre-test and post-test to measure variations on critical thinking skills and reading habits-related attitudes of prospective classroom teachers. During the 10-week experimental process, articles based on socioscientific issues from a popular Turkish science magazine (Science and Technique [TÜBİTAK - Bilim ve Teknik]) were read with prospective classroom teachers (1 course hour per week). After the experimental process, data obtained from the pre-tests and post-tests were analyzed and interpreted.

Study Group

This research was conducted with prospective classroom teachers. The criterion sampling method, one of the purposive sampling methods, was used to form the study group. The predetermined criteria for forming the study group were determined as follows: ease of accessibility, acceptance to participate in the study, and taking the Science Teaching course. The reason why "taking the Science Teaching course" was determined as a criterion was the fact that this course enables students to look at real-world problems from a holistic perspective and become more aware of socioscientific issues. In this context, the study group consisted of 15 third-year prospective classroom teachers studying at the Department of Classroom Teaching, Faculty of Education of a university located in Turkey's Central Anatolia Region. Of the participants, 11 were females and four were males.

Experimental Process

The experimental process started with the planning of a reading group consisting of prospective classroom teachers. The researcher informed the prospective classroom teachers

about the purpose of the study and determined the volunteering students. Then, the researcher informed these students about the experimental process. The process began at the day and time that was convenient for everyone.

The researcher preferred to read socioscientific issues-based articles from the "Science and Technique (Bilim ve Teknik)" magazine published monthly by the Turkish Scientific and Technological Research Council (TÜBİTAK). Although many popular science magazines are published in Turkey, Bilim ve Teknik, published since 1967, is the oldest science magazine in Turkey and is also recommended by the MoNE. Also, the purposes of the magazine include introducing scientific and technological studies to the public and explaining in a clear and understandable language the recent developments in basic and applied sciences and the inventions and innovations in these fields (Science and Technique [Bilim ve Teknik], 2020). The researcher decided on this magazine for these reasons and chose the articles about socioscientific issues in the magazine. These articles were about current and popular scientific developments that are discussed widely and that caused dilemmas among people. Once the articles were determined, they were submitted to an expert who was asked to examine them in terms of suitability for the purpose and comprehensibility. After receiving the expert's feedback, the articles were put in order to be read in the process. The articles based on socioscientific issues are presented in Table 1:

Table 1. Socioscientific issues-based articles

Activity No	Article Title	Impressum (Science and Technique) [Bilim ve Teknik]
1	Do Antidepressants Work?	Özlem Ak, Science and Technique (Bilim ve Teknik), May 2019, Issue 618, pp.40-46.
2	Super Soaps Cleaning Environmental Pollution	Özlem Kılıç Ekici, Science and Technique (Bilim ve Teknik), June 2019, Issue 619, pp.70-75.
3	Artificial Intelligence and Cyber Wars in the Future	Utku Köse, Science and Technique (Bilim ve Teknik), May 2019, Issue 618, pp.76-84.
4	SpaceX Has Launched Its First 60 Satellites for Internet Web	İlay Çelik Sezer, Science and Technique (Bilim ve Teknik), July 2019, Issue 620, pp.10-11.
5	Would You Wear Digital Clothing?	Gürkan Caner Birer, Science and Technique (Bilim ve Teknik), July 2019, Issue 620, pp. 14-25.
6	Deepfake Videos	Gürkan Caner Birer, Science and Technique (Bilim ve Teknik), August 2019, Issue 621, p.44.
7	Waterproof Fabrics Generate Energy from Wind and Rain	Tuncay Baydemir, Science and Technique (Bilim ve Teknik), July 2019, Issue 620, p.7.
8	Technological Steps in Combating Space Debris	İlay Çelik Sezer, Science and Technique (Bilim ve Teknik), July 2019, Issue 620, pp.10-11.
9	Global Health Under Threat: Anti-Vaccination	İlay Çelik Sezer, Science and Technique (Bilim ve Teknik), September 2019, Issue 622, pp.14-37.
10	Self-Destructing Plastics	Mahir E. Ocak, Science and Technique (Bilim ve Teknik), October 2019, Issue 623, p.7.

The socioscientific issue was informed to the prospective classroom teachers in advance, who were asked to read the articles so that they could have some prior knowledge. Each week the lesson started with an engrossing problem situation and then continued reading that week's article. The reading of the determined socioscientific issue-based article was tried to be supported by visual and auditory tools. Then, the participants discussed and analyzed the socioscientific issues (using brainstorming and buzz groups). Afterward, the participants were asked to present their decisions about the determined subject, situation, or event. Each week's activity ended with a general evaluation, feedback, and corrections (if needed). Each activity took about 45 minutes (1 course hour), and the whole process continued for 10 weeks.

Data Collection Tools

Data collection tools were the "Critical Thinking Skills Questionnaire" and the "Attitude Scale towards Reading Habits." The "Critical Thinking Skills Questionnaire" was developed by Sarıgöz (2014) to measure prospective teachers' critical thinking skills. The questionnaire consists of a single factor and 22 5-point Likert-type items (1=Strongly Disagree, 2=Disagree, 3=Undecided, 4=Agree, and 5=Strongly Agree). The questionnaire's Cronbach's Alpha internal reliability coefficient was calculated as 0.80 in the original study. The "Attitude Scale towards Reading Habits" was developed by Gömleksiz (2004) to measure university students' attitudes towards and opinions about reading. The scale consists of six sub-dimensions (like, habit, necessity, claim, effect and benefit) and 30 5-point Likert-type items. The positively-worded items on the scale are scored as 5, 4, 3, 2, 1 starting from the "Strongly Agree" whereas the reverse-coded ones are scored just in the opposite manner. The total score obtained from the scale expresses the reading habits-related attitudes of prospective teachers. The scale's Cronbach's Alpha internal reliability coefficient was calculated as 0.88 in the original study. The items in both data collection tools were examined by the researcher. After consulting with the experts about the suitability of the measurement tools, both data collection tools were applied to the participants as a pre-test and a post-test before and after the experimental process.

In this study, the internal reliability coefficients of the data collection tools were calculated. Critical Thinking Skills Questionnaire pre-test 0.80, post-test 0.78; Attitude Scale towards Reading Habits pre-test was calculated as 0.73 and the post-test as 0.79, and it was determined that the data collected from the data collection tools were reliable.

Data Analysis

The SPSS and Excel package software was used for the analysis of data obtained from the measurement tools. For data analysis, first, the reverse-coded items were evaluated. Afterward, Kolmogorov-Smirnov[a] and Shapiro-Wilk tests were conducted to test the normality of data distribution. Since the number of data was less than 29 in this study, the results of the Shapiro-Wilk test were evaluated, and it was found that the mean scores were normally distributed as the results were greater than 0.05 for both the pre-test and post-test, and the skewness and kurtosis coefficients were between +1 and -1. However, according to Tabachnick and Fidell, when it is not between +1 and -1, the range of +2 to -2 is acceptable (as cited in Demir, Saatçioğlu, & İmrol, 2016). Table 2 presents the results of the normality test applied to the pre-test and post-test scores from the "Critical Thinking Skills Questionnaire" and the "Attitude Scale towards Reading Habits."

Table 2. Results of the normality test applied to pre-test and post-test scores

		Kolmogorov-Smirnov[a]			Shapiro-Wilk			Skewness Values	Kurtosis Value
		Statistic	df	Sig.	Statistic	df	Sig.		
Critical Thinking Skills Questionnaire	Pre-test	0.170	15	0.200	0.943	15	0.423*	0.064/0.580	-0.658/1.121
	Post-test	0.215	15	0.060	0.886	15	0.059*	-0.955/0.580	0.311/1.121
Attitude Scale towards Reading Habits	Pre-test	0.133	15	0.200	0.951	15	0.542*	-0.301/0.580	-0.956/1.121
	Post-test	0.126	15	0.200	0.975	15	0.927*	0.314/0.580	0.640/1.121

*p>0.05

The results of the Shapiro-Wilk test yielded a normal distribution (p>0.05) for the pre-test and post-test critical thinking skills questionnaire and attitude scale towards reading habits, and the coefficients of skewness and kurtosis were found to be between +2 and -2. Hence, as a result of the analyses, it was decided to use parametric measurements for pre-test and post-test data analysis. A dependent sample t-test was used to analyze the difference between the participants' mean scores from the pre-tests and post-tests, and the effect size (eta squared [$\acute{\eta}^2$]) was calculated according to the variances between the scores. The calculation method (*Cohen's d* formula) suggested by Cohen was used in the effect size calculation.

FINDINGS

The present study was undertaken to determine the effect of socioscientific issues-based popular science readings on prospective classroom teachers' critical thinking skills and reading habits. Findings for the sub-problems posed for the purpose of the research are given below, respectively.

Prospective Classroom Teachers' Critical Thinking Skills Before and After Socioscientific Issues-Based Popular Science Readings

The participants' mean scores from the pre-test and post-test critical thinking skills questionnaire are given in Figure 3.

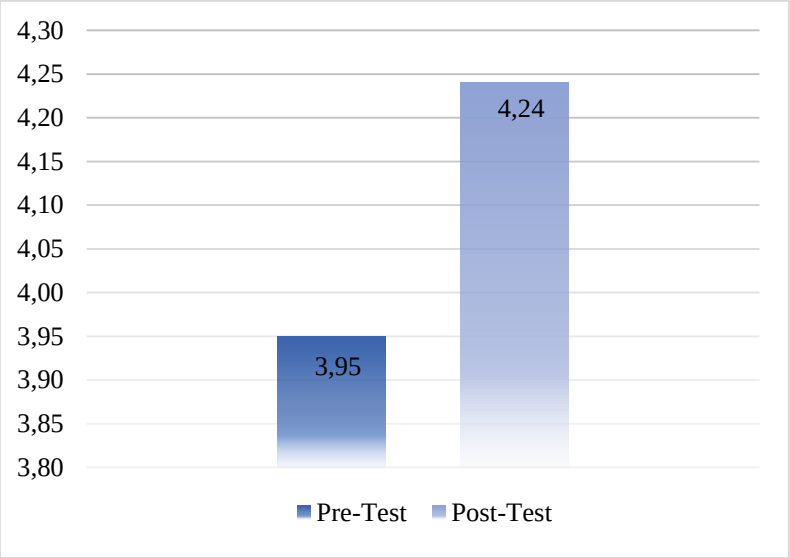

Figure 3. Mean scores from the pre-test and post-test critical thinking skills questionnaire

It was found that the participants' mean score from the post-test critical thinking skills questionnaire was higher than their mean score from the pre-test critical thinking skills questionnaire. Later, the participants' mean scores from the pre-test and post-test critical thinking skills questionnaire were compared using the dependent samples t-test. The results are presented in Table 3.

Table 3. Comparison of mean scores from the pre-test and post-test critical thinking skills questionnaire using the dependent samples t-test

	N	$\overline{X}$	**Standard Deviation**	**df**	**t**	**p**	$ή^2$
Pre-test	15	3.95	0.25	14	-3.179	0.007	1.14
Post-test	15	4.24	0.26				

t(14)=-3.179; p=0.007; $ή^2$=1.14

As can be inferred from Table 3, there is a statistically significant difference between the participants' mean scores from the pre-test and post-test critical thinking skills questionnaire ($p<0.05$). Thus, the H_0 hypothesis was rejected. The effect size ($ή^2$) of the difference between pre-test and post-test mean scores was calculated as 1.14 (*Cohen's d*), which indicates a large effect size since it is $d>0.8$ (Kılıç, 2014). Thus, it can be said that socioscientific issues-based popular science readings greatly enhanced the critical thinking skills of prospective classroom teachers.

Prospective Classroom Teachers' Reading Habits-Related Attitudes Before and After Socioscientific Issues-Based Popular Science Readings

The participants' mean scores from the pre-test and post-test scale towards reading habits related attitudes are given in Figure 4.

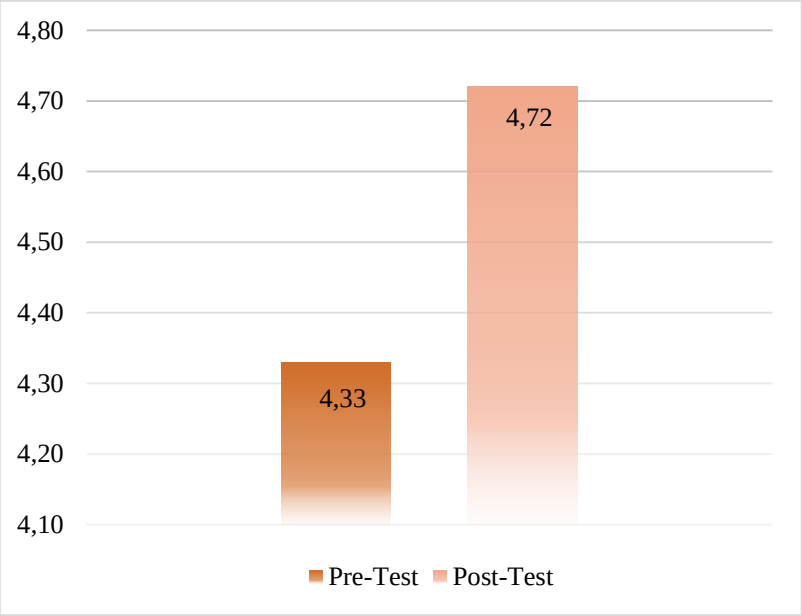

Figure 4. Mean scores from the pre-test and post-test scale towards reading habits-related attitudes

It was found that the participants' mean score from the post-test scale towards reading habits-related attitudes were higher than their mean score from the pre-test scale towards reading habits-related attitudes. Later, the participants' mean scores from the pre-test and post-test scale towards reading habits-related attitudes were compared using the dependent samples t-test. The results are presented in Table 4.

Table 4. Comparison of mean scores from the pre-test and post-test scale towards reading habits-related attitudes using the dependent samples t-test

	N	$\overline{X}$	**Standard Deviation**	**df**	**t**	**p**	$\acute{\eta}^2$
Pre-test	15	4.33	0.32	14	-3.815	0.002	1.59
Post-test	15	4.72	0.13				

t(14)=3.815; p=0.002; $\acute{\eta}^2$=1.59

As can be inferred from Table 4, there is a statistically significant ($p<0.05$) difference between the participants' mean scores from the pre-test and post-test scale towards reading habits-related attitudes. Thus, the H_0 hypothesis was rejected. The effect size ($\acute{\eta}^2$) of the difference between pre-test and post-test mean scores was calculated as 1.59 (*Cohen's d*), which indicates a large effect size since it is $d>0.8$ (Kılıç, 2014). Thus, it can be said that socioscientific issues-based popular science readings positively affected the reading habits-related attitudes of prospective classroom teachers.

DISCUSSION

This study investigated the effect of socioscientific issues-based popular science readings on critical thinking skills and reading habits-related attitudes of prospective classroom teachers. To this end, a reading group was formed with prospective classroom teachers, and the articles on socioscientific issues in the Science and Technique (Bilim ve Teknik) magazine were examined. Each activity took about 45 minutes (1 course hour), and the whole process continued for 10 weeks. Socioscientific issues-based teaching makes topics with scientific content, in which students are not interested and which may be considered

boring, more interesting and enjoyable (Dolan, Nichols, & Zeidler, 2009). Thus, the learning process is taken to another dimension, and socioscientific issues-based activities can serve as a tool for students to gain a perspective towards the world and science and to question and interpret real-life situations.

The study found a statistically significant difference ($p<0.05$) between the participants' mean scores from the pre-test and post-test critical thinking skills questionnaire applied before and after socioscientific issues-based popular science reading activities, and the effect size ($ή^2$) of the difference between pre-test and post-test mean scores was calculated as a large effect size. Critical thinking is not an inherited skill: it can be learned, taught, and improved (Göbel, 2013). Cleveland (2015) underlined the importance of using picture books in science teaching and argued that these books constituted a good context for science learning and could be used as an effective teaching tool to develop critical thinking skills in students. Büyükkanber and Makaracı (2015) stated that textbooks had an instruction style that does not allow students to think differently, and that includes precise judgments, suggesting that starting from kindergarten, it is necessary to create and use resources that can develop children's critical thinking skills. Theoretical courses taken by prospective classroom teachers during their undergraduate education have been deemed insufficient in terms of enhancing their critical thinking skills (Yeşilpınar, 2011). Moreover, faculties of education lack educational practices that support critical thinking skills in students (Özelçi, 2012). In this regard, the process designed in this study can be used to contribute to prospective teachers' critical thinking skills. Gray and Bryce (2006) stated that students should have the basic infrastructure and skills that are necessary to make informed judgments and decisions about the developments encountered in the media or everyday life. They also suggested that socioscientific issues containing social, moral, and ethical issues as dilemmas should be included in all educational processes. Açışlı (2016) found that prospective classroom teachers scored quite high scores from the "analytical thinking" sub-dimension of the "critical thinking dispositions" scale, attributing their high scores to their ability to be cautious, to reason, and to use objective evidence in potentially problematic situations. Similarly, in this study, prospective classroom teachers analyzed popular science articles about socioscientific issues, discussed them with others, and were able to look at the issues critically. In a study conducted by Pelger and Nilsson (2016), students were asked to write projects in a plain language that the people could understand, and then, using a questionnaire, they were asked to express how such a writing style contributed to them. The students stated that such a writing style enabled them to change their perspectives on issues, providing them with an opportunity to look at their projects from a different point of view. From this point of view, popular science readings, with their plain and simple language, can help one develop a critical look at issues and situations. In this study, the researcher supported popular science readings with socioscientific issues, the dilemmatic nature of which required the participants to use and thus improve their critical thinking skills.

The fact that the reading activities carried out in this study focused on socioscientific issues, which left the participants in dilemmas and therefore had them discuss the issues, may have been effective in improving prospective classroom teachers' critical thinking skills. After reading popular science articles, the participants shared their opinions with other participants, rejected or supported the ideas put forward in the articles, and had the opportunity to view socioscientific issues from different perspectives. Open-ended questions to be asked after reading popular science articles can be very useful in developing skills such as critical thinking, analyzing, developing original solutions to problems, and high-order thinking (Baştuğ, Hiğde, Çam, Örs, & Efe, 2019). In their study, which aimed to develop critical

thinking skills through group work, Fung and Howe (2012) found that discussions held during group work activities positively affected the experimental group's post-test scores from the critical-thinking test. In another study, Babacan (2017) asked middle school students to carry out a scientific argumentation in a group activity involving socioscientific issues. The author found that these activities improved students' critical thinking skills. Sevgi and Şahin (2017) asked students to discuss socioscientific issues in newspaper reports using argumentation, thus contributing to the development of students' critical thinking skills. Similarly, this study went beyond merely conveying information to students, which is a widely adopted traditional teaching method, and used socioscientific issues-based popular science readings, which increased active participation among prospective classroom teachers and created a learning setting that helped them think critically, discuss, and interact with others. Thus, the study contributed to the development of prospective classroom teachers' critical thinking skills.

Another noteworthy finding obtained in this study is that there was a statistically significant difference ($p<0.05$) between the participants' mean scores from the pre-test and post-test scale towards reading habits-related attitudes applied before and after socioscientific issues-based popular science reading activities, and the effect size ($ή^2$) of the difference between pre-test and post-test mean scores was calculated as a large effect size. Individuals improve their reading skills by increasing their vocabulary and using reading comprehension strategies to make sense of what they have read. In the following stages of education, the ability to make sense of what has been read deepens (Aşuluk, 2020). If individuals want to acquire reading habits and develop an attitude towards reading, it is necessary to make the act of reading enjoyable and interesting (Calkins, 2001). Thus, individuals start to see this as a part of their lives, develop a positive attitude to reading and in this way tend to continue the reading habit (Yıldız et al., 2017). Lai and Chan (2020) found that picture books helped children use their reading skills in science learning, thus providing more learning and increasing academic success. This is because the reading skill is not one-dimensional: it involves multidimensional mental processes that occur at different levels and highlights the interaction between the reader, writer, and text in all its dimensions (Aşuluk, 2020). In another study, it was found that reading scientific stories increased children's curiosity and interest in the lesson, made abstract concepts easier to understand, helped achieve permanent learning, and provided an enjoyable and positive learning environment. Thus, it was concluded that it affects students effectively by developing interest, curiosity, motivation and desire towards the lesson (Gölcük, 2017), and this result is considered important in providing reading habits-related attitudes. In primary schools, tales, stories, and informative texts are used widely in Turkish classes: through activities that require students to comprehend, interpret, and analyze what they have read, it is aimed to help students develop towards reading habits-related attitudes (MoNE, 2018). On the other hand, considering the features of popular science publications, they are more accessible than other books and can be understood by a wider range of people, which can be effective in helping students develop positive attitudes towards science (Eroğlu & Sağlam, 2020). Developed and developing societies use different methods and techniques and develop different projects in order to help individuals acquire reading habits, increase their interest in reading, and enable them to exhibit positive attitudes towards reading (Karadağ, 2014). When evaluated from this point of view, this reading experience supported by a different activity can be considered as an opportunity. Socioscientific issue-based popular science readings have attracted the attention of prospective classroom teachers and positively affected their reading habits-related attitudes. Moreover, the participants realized that, in addition to Turkish classes in primary schools, popular science readings that can be carried out in science classes could also be effective in helping primary school students develop reading habits. In a study by Majetic and Pellegrino (2014), undergraduate students

analyzed science-related news reports in the media according to certain criteria, and it was found that this had a positive effect on the reading skills of the undergraduate students participating in the study. Ünlüer (2008) used newspapers, which are considered one of the traditional media channels, in social studies classes in a primary school. At the end of the process, students stated that using newspapers in social studies classes improved their reading and reading comprehension skills.

Teachers who raise future generations are expected to gain awareness of socioscientific issues directly related to life and be able to understand, interpret, and critically evaluate popular media instruments (newspapers, science magazines, internet, etc.) (Öztürk & Erabdan, 2018). Students encounter many scientific issues and situations in their families, schools, and communities, have difficulty making decisions, and thus perceive these issues as a problem. Therefore, it is argued that schools and teachers must undertake the responsibility of addressing such issues (McCrory, 2020). Hence, while preparing for their future professional lives, prospective teachers need to experience the contribution of socioscientific issues to their educational process. Socioscientific issues-based activities that help students realize that such issues are present in the real world and that promote student engagement in classes should be increased (Sevgi & Şahin, 2017). In this way, students can be informed about both the world and the innovations brought about by the developing technology; moreover, they can be more motivated to follow studies on socioscientific issues (Gürbüzkol & Bakırcı, 2020). Therefore, socioscientific issues-based popular science readings should be evaluated by teachers as an opportunity to achieve this. Also, science magazines, posters, and newspaper articles, which are among the popular media instruments, can be used as an important resource for educational studies to ensure the sustainability of knowledge (Yazır & Yel, 2017).

In this study, it was found that socioscientific issues-based popular science readings significantly increased the critical thinking skills and reading habits-related attitudes of prospective classroom teachers. Socioscientific issues-based activities can promote students' critical thinking skills by helping them discuss complex issues more effectively. Such processes to be designed with various activities can make the teaching process more enjoyable and increase student engagement in the lesson. In addition, reading habit is one of the important behaviors that students should gain from the first years of primary school. Because the reading habits and diversity acquired at early ages have a very important effect on the mental development and social maturation of individuals. Considering that attitudes are formed late and are difficult to change, it will be beneficial to organize activities for reading books starting from younger age groups and to ensure the participation of students in activities for the development of this attitude (Arslan & Çelik, 2009). Martin et al. (2018) found that most of the illustrated children's books raised awareness in children about the effects of human activities on the environment, thus helping them become informed about recent developments. They also noted that interesting illustrated children's books increased student participation in classes by helping them have more fun. Yavuzoğlu and Pektaş (2020) examined the "Science Kids (Bilim Çocuk)" magazine published monthly by TÜBİTAK. They found that conceptual understanding was included more in the scientific stories in the magazine. Furthermore, they stated that the magazine also attached much importance to activities that enhance students' higher-order thinking skills, such as critical thinking, discussing, making inventions, researching, designing experiments, and applying. It is thought that socioscientific issues-based popular science reading activities carried out with a sample of prospective classroom teachers contributed to both the relevant literature and the professional development of prospective teachers. Various popular science magazines for prospective teachers (Science and Technique [TÜBİTAK Bilim ve Teknik], National

Geographic, Atlas, Popular Science [Popüler Bilim], etc.) and for primary school students (Science Kids [TÜBİTAK Bilim Çocuk], TRT Children's Magazine [TRT Çocuk Dergisi], National Geographic Kids Turkey, Atlas Kid [Atlas Çocuk], Wise Kid [Bilge Çocuk], Researcher Kid [Araştırmacı Çocuk], etc.) can be included in educational processes through in-class and out-of-class activities. Thus, students can be provided with funny and engrossing learning settings where they can gain awareness about, discuss, and analyze real-world problems. At the same time, the realization of different types of reading experiences in the education process can be seen as effective in gaining affective characteristics related to reading habits and developing positive attitudes and thoughts towards reading. In addition to this study, other research can be conducted with prospective classroom teachers and primary school students using popular science reading activities or socioscientific issues-based articles. Using different data collection tools in future studies can also help analyze different dimensions of designed activities. Finally, results from various studies can be compared to determine the effectiveness of designed processes.

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