

THE EFFECT OF OUT-OF-SCHOOL SCIENCE LEARNING ENVIRONMENT ON THE UNDERSTANDING THE NATURE OF SCIENCE OF THE 7TH GRADE STUDENTS IN SECONDARY SCHOOL

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ABSTRACT

The purpose of this research is to examine the effects of out-of-school science learning environments on the understanding of the science nature of seventh-grade students in secondary school. In this study, pre-test post-test group pattern model was used. The participants of the survey consisted of 22 students who attended the 7th grade in the village school of Göynücek in Amasya. Within the scope of the research, The Nature of Science Instrument developed for middle school students was used. SPSS 21 package program was used to analyse the data. As a result of the data analysis, the average of the total scores of the students from the preliminary test was 25.04 whereas the average of the total scores from the final test was 27.86. A statistically significant difference was found between the mean scores of the pre-test and post-test total scores of the t test for the dependent groups [$t(21) = -4.38, p=0.00$]. This difference is in favour of the final test total score averages. When the findings are examined, it can be concluded that the extracurricular learning environment is effective in increasing the understanding of the nature of science by secondary school 7th grade students. The activities of the out-of-school learning environment can be organized in a long-term so that the nature of science can be explored in terms of different variables.

Keywords: *science teaching, informal learning, scientific knowledge, out-of-class teaching*

INTRODUCTION

One of the important, indispensable conditions for effective science teaching is to understand the nature of science. It is difficult to make a precise definition of the concept of the nature of science and this case is still a debate in literature (İnce & Özgelen, 2015; Lederman, Antink, & Bartos, 2014; Matthews, 1994). The reason is that science has a constantly changing structure. Vesterinen and Aksela (2013) have identified the nature of science as a system that explores what science means, how scientists operate and how they are organized, how people react to scientific research, how they direct, and interaction between science and society. It is very important to ensure students understand the nature of science and develop their understanding, in addition to having scientific literacy (American Association for the Advancement of Science, 1993). According to some researches, despite the emphasis on the nature of science, students do not have very clear and correct views about the nature of science (Akerson & Hanuscin, 2007; Bell & Lederman, 2003; Khishfe, 2008).

Unfortunately, students are not fully equipped to understand the nature of science (Lederman, 1992). However, according to Hanuscin and Hian (2009), students who do understand the nature of science will become crucial as they will be more sensitive to scientific matters, discovering scientific problems, consistent in their learning and problem solving and appreciating it. In this case, students who are able to discover the nature of science will be more successful in understanding the subjects and concepts related to science in the learning activities of the course.

In recent years, science education researches have shown that students' understanding of the nature of science has become an important point (Hacieminoğlu, Yılmaz-Tüzün, & Ertepinar, 2012; Kang, Scharmann, & Noh, 2005; Khishfe & Lederman, 2006; Özcan & Turgut, 2014). In Turkey, emphasis has been given to the teaching of the nature of science through the 2013 science curriculum (MoNE, 2013). In order to teach the 'nature of science' better, it is important to incorporate the concept 'nature of science' into science education (Hogan, 2000). It is important to understand the nature of science by living and to reach the knowledge by using scientific process skills in science education (Can & Pekmez, 2010). However, there are shortcomings about how the nature of science is taught (Önen Öztürk, 2015). The elimination of these shortcomings may be of importance to the planned education for the out-of-school science learning environments. Out of school science learning environments contribute to the development of skills such as the development of students' skills in science, the discovery of various scientific issues, the development of favourable attitudes towards science, the creation of scientific curiosity and the simplification of learning and the opportunity to acquire firsthand experience, linking everyday life with school learning (Bakioğlu & Karamustafaoğlu, 2014; Sontay, Tutar, & Karamustafaoğlu, 2016; Sontay & Karamustafaoğlu, 2017). In this context, it can be said that these important acquisitions obtained from the out-of-school science learning environments are related to the scientific understanding of nature.

When the literature was investigated, it has been seen that the number of studies carried on out of school science learning environment were quite few (Behrendt & Franklin, 2014; Cavallo, 2008; Liu & Lederman, 2002; Metin, 2009). With this research, it is expected that a scientific visit to the Central Research Laboratory (CRL) in Amasya University will provide a better overview on how scientists work and acquire scientific evidence alongside an understanding of what the experimental nature of scientific knowledge is, and how it is close to observe the data collection and observations while solving problems in scientific research. This study can enlighten future studies and contribute to further understanding on the topic of the research. Moreover, this research is also important to teach concrete and abstract concepts related to the nature of science by first-hand experiencing.

The purpose of this research is to examine the effects of out-of-school science learning environments on the understanding of the science nature of seventh-grade students in secondary school. For this purpose, the main problem of this research is to investigate whether the learning environment of the out-of-school influences the 7th grade secondary school students' understanding of science. The purpose of this research is not only important within Turkey but also in other countries where science teaching activities is carried out in schools. After all, understanding the nature of science is a universal issue which is necessary in order to understand science. Through this research, the effects of the events organized in the out-of-school environment are investigated.

METHODOLOGY

In this study, pre-experimental design model with one group pre-test and post-test was used. The reason is that it is not possible to find or use the control group (Christensen, Johnson, & Turner, 2014). In this context, the research was carried out with this design as one of the researchers was working in the particular school and there is only one 7th grade. There is a randomly chosen experimental group in this model. Pre-test was given to this group ($O_{1,1}$) before the experimental intervention (out-of-school learning environment) and post-test was introduced ($O_{1,2}$) after the intervention and the same measurement tool is used in both applications (Özmen, 2016). The schematic view of the design is presented in Table 1.

Table 1

Research Design of This Study

Group	Pre-test	Application	Post-test
G ₁	O _{1/1}	X	O _{1/2}

G₁: Research group O_{1/1}: Pre-test (Before application) X: Application O_{1/2}: Son-test (After application)

Study Group

The participants for the research consisted of 22 students attending the 7th grade in the village school of Göynücek in the province of Amasya who are studying in 2015-2016 academic year. Nine out of 22 students are male and thirteen are female.

Data Collection Tool

Within the scope of the research; Nature of science instrument, developed by Hacıeminoğlu et al. (2012) for secondary school students, was used as data collection tool. In the study in which this questionnaire was used, a total of 782 students participated to this survey attending to the 6th, 7th and 8th grades. In the 13-item questionnaire, the answers for each item were scored from 1 to 3. A minimum of 13 points and a maximum of 39 points can be taken from the questionnaire. The Cronbach Alpha reliability coefficient of the Nature of science instrument was 0.76. Explanatory factor analysis and confirmatory factor analysis were performed for the validity of the data collection tool. According to the explanatory factor analysis, the data collection tool consists of 4 factors explaining 64.34% of the variance. These are called observation and deduction, the uncertain nature of science, imagination and creativity, and the experimental nature of science. For the data collection tool, confirmatory factor analysis was also examined and GFI, AGFI, RMSEA compliance indices were calculated. According to these calculations; The GFI value was determined as 0.98, the AGFI value as 0.97, and the RMSEA value as 0.068. Therefore, the Nature of science instrument was used as a valid and reliable measure of the scale.

Data Collection Process

In the scope of the research, firstly, a trip plan was made to visit the CRL in Amasya University and permissions were taken from the parents. The necessary legal procedures were completed before the trip and the expert teaching staff responsible for CRL was interviewed and guided by the students during the trip. In the framework of this trip plan, Nature of science instrument was applied to participant students before the application. Later the students visited the CRL. During the trip, the offices where scientific researches were carried out were visited one by one and the students received information how the scientists worked and how they organized their scientific studies. The purpose of this trip for the students was to understand the nature of science. In order to realize this purpose, the offices where the scientists worked, experiments and observations were examined and sample scientific analysis were made in front of the students. With the expert teaching staff after the trip, students were asked questions such as what they expected about the trip, whether the expectations were met, and whether some of the scientific considerations that the students had beforehand changed. It was an educational trip that lasted about 2.5 hours. The Nature of science instrument was applied again after the trip. Pictures related to trip were presented in Picture 1 and Picture 2.



Picture 1. Introduction of CRL Trip



Picture 2. CRL Discussion after the Trip

Analysis of Data

SPPS 21 packet program was used to analysed the data. In the analysis of the data, it is observed whether the data was distributed normally or not to apply the paired group t-test. To apply the t-test for dependent groups, the difference in scores of the two related measurement sets should show a normal distribution (Demir, Saatçioğlu, & İmrol, 2016). Shapiro-Wilk test and skewness and kurtosis values were examined for normal distribution analysis. According to Shapiro and Wilk (1965), the Shapiro-Wilk test is suitable if the sample size is less than 35 (Demir, Saatçioğlu, & İmrol, 2016). The fact that the p-significance value calculated because of the Shapiro-Wilk test is greater than .05

($p=0.53$) proves that the scores have a normal distribution at this significance level (Mertler & Vannatta, 2005). In addition, the results of the analysis that the skewness value was -0.490 and the kurtosis value was 0.006 were determined as a result. The fact that the skewness and kurtosis values are close to 0 between $+1$ and -1 can be shown as evidence that the data show normal distribution (Tabachnick & Fidell, 2013). In this context, it has been found that the data are normally distributed as a result of the analysis carried out and the precondition is fulfilled so that parametric tests can be applied in the analysis of the data.

The dependent groups t-test (paired t-test) was used to determine whether pre-test and post-test scores differed.

FINDINGS

In this section, the findings of students' pre-test and post-test scores, descriptive statistics of pre-test and post-test average scores, and t-test results of dependent groups on pretest and post-test mean scores are presented.

The pre-test, post-test and difference scores of students' answers are presented in Table 2.

Table 2
Students' Pre-Test, Post-Test and Difference Points

Student Queue No	Pre-test Score	Post-test Score	Difference Score
1	28.00	30.00	2.00
2	24.00	26.00	2.00
3	22.00	26.00	4.00
4	21.00	30.00	9.00
5	28.00	28.00	.00
6	24.00	31.00	7.00
7	25.00	22.00	-3.00
8	23.00	26.00	3.00
9	29.00	31.00	2.00
10	24.00	26.00	2.00
11	26.00	23.00	-3.00
12	26.00	28.00	2.00
13	28.00	33.00	5.00
14	30.00	31.00	1.00
15	22.00	28.00	6.00
16	28.00	30.00	2.00
17	26.00	26.00	.00
18	22.00	23.00	1.00
19	25.00	31.00	6.00
20	22.00	28.00	6.00
21	23.00	28.00	5.00
22	25.00	28.00	3.00

When Table 2 is examined, it is seen that the difference is 9 points in favour of the post-test and the difference is 3 points in favour of the pre-test according to the answers given.

The pre-test and post-test analysis results according to the answers given by the students to the Nature of science instrument are presented in Table 3.

Table 3

Nature of Science Instrument Descriptive Statistics for Pre-test and Post-test Average Scores

Measurement	Mean Score	N	Standard Deviation	Standard Error
Pre-test	25.04	22	2.60	0.55
Post-test	27.86	22	2.91	0.62

When Table 3 is examined, descriptive statistical values of students' responses to the Nature of science instrument are seen. Accordingly, the post-test scores of the students were found to be higher than the pre-test scores. To determine whether this difference was statistically significant, t-test analysis of dependent groups was performed in Table 4.

Table 4

Nature of Science Instrument Results of t-test for Dependent Groups of Pre/Post-test Average Scores

Correlation	Mean	Standard Deviation	Standard Error	t	Degrees of freedom	of p
Pre-test/ Post-test	2.81	3.01	0.64	-4.37	21	0.00*

* $p < .05$

When Table 4 was examined, there was a significant difference between the pre-test and post-test scores averages of the students in the nature of science instrument ($p < 0.05$). This difference is in favour of post-test scores averages.

DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

In this section, the literature supported the discussions on the findings obtained from this research and based on the discussions and the recommendations presented in the light of the results are given. The fact that there is only one experimental group in this study, in other words, the absence of the control group, is the limit of research. The research is limited related to the teaching period, the data collection tool and out-of-school learning activities.

Discussion

At the end of the data analysis, the mean of the total scores of the students from the pre-test was 25.04, while the mean of the total scores from the post-test was 27.86. Dependent groups t-test was used to determine whether this difference was statistically significant, and a statistically significant difference was determined between the pre-test and post-test total mean scores [$t(21) = -4.37, p = 0.00$]. This difference is in favour of the post-test total scores averages. Therefore, it can be considered that out-of-school learning environments have a positive effect on the understanding of the science of 7th grade students secondary school students. It is possible to come across similar studies supporting this idea (Behrendt & Franklin, 2014; Cavallo, 2008; Liu & Lederman, 2002; Metin, 2009; Toz, 2012). When the relevant literature is examined, the study by Liu and Lederman (2002) of gifted students in Taiwan shows that approximately one-week science camp has improved on "creativity" and "scientific subjectivity" from the scientific themes of experience with 7th grade students in the nature science activities. In addition, Metin (2009) and Balım, Deniz-Çeliker, Türkoğuz and Kaçar (2013) reached the conclusion that science and nature activities had a positive effect on scientific process skills in their 6th and 7th grade secondary school students studying in public schools. Furthermore, according to the science teachers, students benefit from the activities that happen outside the school environment and they question these activities while practising or observing them (Bjønness & Knain, 2018). Science camps or science and nature activities are important events that take place outside the school. The development of the scientific nature of these activities supports the findings of this study.

In out-of-school science learning environments, students who are curious about a problem conduct research, experiment, and take responsibility to solve the problem (Thomas, 2010). Bruer (1993) also noted that students use school science in their school experiences. Behrendt and Franklin (2014) stated that field trips provided students with convenience in accessing scientific information and observation in scientific research. Students must learn by doing-living and to learn in a way that what the scientists are doing, and such an experience affects their understanding of nature of science positively (Balım et al., 2013). Moreover, the scientific inquiry realized outside school environment can help students increase their scientific literacy and understand the nature of science (Lederman, Lederman, & Antink, 2013). In this context, it can be said that the out-of-school learning environments and the natural themes of science overlap and activities outside the school increase the scientific knowledge that the students possess.

CONCLUSION

In light of the interpretations of the findings, it was concluded that the educational trip to the out-of-school learning environment positively influenced the 7th grade secondary school students' understanding of science. Increasing the understanding of the nature of science in the students will make it easier for the practitioners to work in the campus and events organized for the teaching of the nature of science in the recent times. Thus, the effects of out-of-school teaching activities on the nature of science are considered and it is considered that this will contribute to the researchers who will work on issues related to the outdoor education and nature of science. Depending on the outcomes of the research, it was understood that it would be easier for students to understand the nature of science if the out-of-school learning environments were organized in a planned and organized way.

RECOMMENDATION

Depending on the outcome of the research, the following suggestions are presented: The impact of out-of-school learning environments on the nature of science can be examined for students at different class levels. Such a study can also be carried out in the context of a semi-experimental method with experimental and control groups. The activities of the out-of-school learning environment can be organized in a long-term so that the effects of 'nature of science' can be investigated through different variables. An in-depth qualitative study can be carried out by students on the impact of non-school learning environments on the nature of science.

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