p-ISSN 2355-5343
e-ISSN 2502-4795
http://ejournal.upi.edu/index.php/mimbar

Article Received: 19/04/2022; Accepted: 09/11/2022
Mimbar Sekolah Dasar, Vol. 9(3), 381-395
DOI: 10.53400/mimbar-sd.v9i3.45472

The Effect of Science Teaching Based on POE Strategy on the Academic Achievement and Attitudes of Fifth-Grade Students in the Distance Education Process

Sevgül Çalış✉[1], Mustafa Özkan [2]

[1] Department of Mathematics and Science Education, *Faculty of Education, Bursa Uludağ University, Turkey*

[2] Science Teacher, Sadettin Türkün Secondary School, Bursa*, Turkey*

✉ scalis@uludag.edu.tr

Abstract. The aim of this study is to examine the effect of science teaching based on POE (Predict-Observe-Explain) technique on the academic achievement and attitudes of fifth-grade students in the distance education process. The study was carried out with the quasi-experimental design of quantitative research methods and an approach in which pretest and posttest applications were applied to the experimental and control groups. The research sample consists of 72 fifth grade students, 36 of whom are in the experimental group and 36 in the control group. Data collection tools included an academic achievement test and an attitude scale regarding learning science. The collected data were analyzed with the SPSS package program. The research results concluded that science teaching based on online POE technique increased the students' academic achievement. Meanwhile, the attitude towards science learning was independent from teaching based on POE strategy.

Keywords: academic achievement, attitude, Science, POE, fifth grade student, distance education

1. Introduction

To keep up with the rapid development of science and technology, individuals must constantly renew themselves. This situation puts individuals in a race, and for the individual to renew himself and come to the fore in this race, it is necessary to produce and develop technologies, not just use them. Since it is extremely important for individuals to structure knowledge and to know the ways to access knowledge, science courses should be prioritized and equipped. Science education provides the opportunity to raise creative individuals who can question, observe, share information, recognize themselves and their environment, and solve problems. For this reason, many countries have restructured their education programs in order to raise scientifically literate individuals who can structure knowledge (Kozcu-Çakır et al., 2017).

1.2. Problem Statement

In Turkey, a new science program was developed in 2004 in order to train all individuals as science and technology literate (M.E.B., 2005). Later, due to changes in education, the same goal was adopted as the old program in 2013, but by switching from the constructivist approach to the investigative-inquiring approach (M.E.B., 2013). However, despite this change, according to the results of PISA (Programme for International Student Assessment) administered in OECD countries and non-OECD countries, it has been observed that in Turkey is quite behind in the field of science (http://www.oecd.org/Pisa/). The purpose of PISA is to determine how well students can transfer the information they learned at school to daily life. In addition, in the exam conducted by TIMSS (Trends in International Mathematics and Science Study), the international educational achievement evaluation organization, it was observed that the fourth- and eighth-grade students were below the general average in science (Büyüköztürk et al., 2014; Şişman et al., 2011; Yildrim, 2016).

Based on these results, the Turkish Ministry of National Education has reorganized the science program to train students as science literate and to achieve the program objectives. In addition, the proposed program has highlighted the necessity of providing students with scientific process skills in science education. In attempting to achieve this objective, many different models have been tried, and the POE technique (Prediction-Observation-Explanation) stands out among them (Bilen & Aydoğdu, 2012; Palmer, 1995). Teaching many subjects in science lessons and associating the activities with real life situations becomes difficult, and this can lead students to memorize concepts (Golin, 2002; Oh, 2011).. Therefore, the POE method is widely used for effective concept teaching (Boo & Watson, 2001; Liew & Treagust, 1995). In the POE method, students investigate the events with their reasons, observe the event, and make explanations to eliminate the contradictions between their predictions and observations. In the POE technique, students are expected to make predictions about a scientific phenomenon by reasoning, and then the reasons are expected to be explained, followed by a strategy to develop explanations based on observations (White & Gunstone, 2014). In the POE technique, students need to support their predictions by using their experience and knowledge about the events they encounter in daily lives.

This study aims at investigating the effect of teaching the "Electrical Circuit Elements" unit in the fifth-grade Science curriculum on the academic achievement and attitudes of the fifth-grade students by being carried out in accordance with the POE method in the distance education process.

1.2. Related Research

POE method is widely used in science education. In analyzing the literature, POE makes contributions in many areas, including academic success, attitude, motivation, concept teaching, and detection of misconceptions(Astiti et al., 2020; Ayvacı, 2013; Durmuş, 2014; Ergül et al., 2020; Hsu et al., 2011; Kiryak & Özdilek, 2019; Smith et al., 2010; Yildiz, 2021). These studies are primarily interested in identifying misconceptions and examining the academic achievements and attitudes of teacher candidates and students enrolled in various levels of education. However, considering the pandemic and possible future pandemics, it was necessary to investigate the applicability of the POE method with distance education in this process. Due to the pandemic, distance education has been carried out in educational institutions throughout the world, including Turkey. For this reason, the positive and negative effects of the applications of the distance education process have been the subject of research. It is thought that increasing the number of studies to be carried out in this field is significant in terms of contributing to the identification of the current situation, improving the existing situation and seeking solutions to the problems.

1.3. Research Objectives

In the literature, there is no study on the effect of online POE method applications on success and attitudes towards the course. The POE method was used online during the distance education process because previous learning took place in various face-to-face classes. Its effect on the academic achievement and attitudes toward the lesson of the fifth-grade students in the teaching of the "Electrical Circuit Elements" unit was investigated. The following research questions have been looked for solutions in keeping with this principle objective.

1. Is there a significant difference in the academic achievement scores of the experimental and control groups for the electrical chapter before and after the application?
2. Did the experimental and control group students' attitudes towards learning science change before and after the application?

2. Theoretical Framework

The POE strategy is effective in science education, and students are allowed to verify and explore their ideas, especially during the prediction and critical thinking phase, with this strategy (Kearney et al., 2001). The POE method for both group and individual activities, which

is commonly expressed as a technique or method, consists of three stages. In each of the three stages that make up the POE technique, there are obligations required from the students.

1. Prediction phase: In the first phase of the method, students are expected to develop logical predictions about the events conducted by the teacher in the experiment and to explain the reasons for these predictions (Liew & Treagust, 1998). Thus, students' estimation skills developed are focused on the experiment and they are motivated. The estimation process in question can be conducted through an activity or open-ended questions (Bodner et al., 1998; White & Gunstone, 2014).
2. Observation Phase: At this stage, the students experiment by making predictions. They should observe this experiment. They should observe this experiment effectively (Driver & Bell, 1986). They should observe this experiment effectively (Kearney & Treagust, 2001). According to Köseoğlu et al. (2014), the phenomenon may need to be repeated in order to make an accurate observation, and the observations should be recorded.
3. Explanation: Students are expected to question the contradictions that emerged in their minds after the observation with the predictions they made at the beginning of the lesson (Liew & Treagust, 1998). At this stage, a general in-class discussion environment is provided under the guidance of the teacher, and students are expected to make explanations. Thus, more specific feedback can be obtained for understanding levels (Köse et al., 2003).

3. Method

3.1. Research Design

This study employed quantitative research with a quasi-experimental design of pretest-posttest control group. This research design was defined as studies in which matched groups according to certain data were randomly assigned as experimental and control groups (Büyüköztürk et al., 2012)). In this study, while the Electricity chapter was studied with POE method applications in the experimental group, the lesson was taught with traditional methods in the control group. The reason for choosing the quasi-experimental design in the study is to reveal the effect of POE applications used in the experimental group.

3.2. Participants

The sample of this study consisted of 72 fifth-grade students studying in a district of Bursa in the 2020-2021 academic year. The study was conducted in the form of distance education due to the pandemic. While creating the sample, the easily accessible sampling method was chosen from the purposive sampling methods because the application and data collection took a long process. The students from the school where the researchers' works were determined. While determining the sample, the two classes closest to each other in science course grades were determined.

3.3. Data Collection

The scale proposed by Çalli (2019), as a data collection tool to determine academic success in the research, was used to measure the fifth-grade students' achievements with electrical circuit elements with the permission of the relevant expert. The scale includes 30 multiple-choice questions. In the evaluation of the questions, the students received 1 point for the correct answer and 0 point for the wrong answer.

The scale developed by Nuhoğlu (2008) was used as the attitude scale towards science learning. The scale consists of 5 sub-dimensions. In addition, the scale can be examined in two themes: Attitudes Towards Science-Technology Lessons and Attitudes Towards Activities in Science-Technology Lessons. The scale is evaluated with a 3-point Likert-type rating and has options such as "I do not agree", "I have no idea" and "I agree". The sub-dimensions of the scale and the item numbers in the sub-dimensions are presented in Table 1.

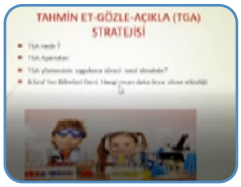
Table 1. The sub-dimensions of the scale and the item numbers in the sub-dimensions

Sub-dimensions of the Scale	**Item Numbers**
Science and Technology Lesson in School	3-4-5-6
Learning and Using New Information	2-8-10-11
Success / Failure in Science and Technology Course	1-7-9
Enjoying Activities in Science and Technology Lesson	12-14-15-17-19-20
Finding Necessary to do Activity in Science and Technology Lesson	13-16-18

The study of Nuhoğlu (2008) shows that the scale explained 56% of the total variance. In the 2020-2021 academic year, lessons were taught with the POE method in the experimental group, and with the teaching method recommended by Turkish Ministry of National Education in the control group. The research consists of a total of six activities, consisting of five experiments, at least one experimental setup, and an observation covering two sub-topics, during the "Electrical Circuit Elements" unit in the fifth-grade Science Curriculum. In the first lesson introduction, the researchers provided background information on the POE strategy and outlined the procedure's each step for the students. The research data collection process was completed in a six-week period along with the pretest-posttest. The data collection tools used in the research are presented in Table 2 and the application stages of the research are presented in Figure 1.

Table 2. Data collection tools

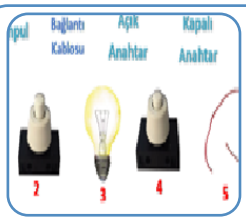
Data Collection Tools	Experimental Group	Control Group
Academic Achievement Test	✓	✓
Learning Science Attitude Scale	✓	✓



FIRST WEEK

Determining the POE activities to be used on the subject.

Procurement of necessary materials. Application of Achievement Test and Attitude towards Learning Science Pretests

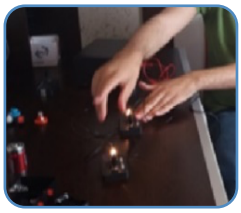


SECOND WEEK

Giving information about TGA applications. Getting started with POE applications.

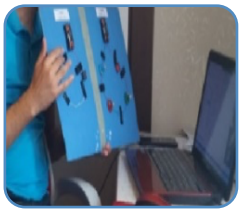
Circuit Elements, Symbols and Circuit Building Activity.

Circuit Matching Observation



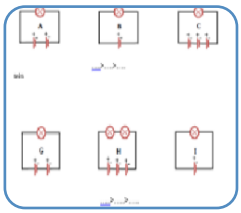
THIRD WEEK

Faulty circuits activity



FOURTH WEEK

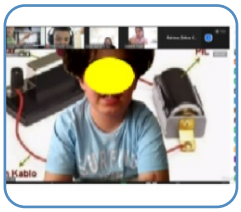
Efficiency of comparing bulb brightnes



FIFTH WEEK

Effect of battery number on bulb brightness..

The effect of the number of bulbs on the brightness of the bulb



SIXTH WEEK

Application of Achievement Test and Attitude Towards Learning Science Posttests

Figure 1. Application stages of the research

3.3.1. Preparation of study activities

The activity sheet was prepared using the visuals related to the "Electricity Chapter" to be used in the application of the POE method. The students participating in the study attended the lesson by connecting via zoom and then the researchers gave information about the activities to be applied. Afterwards, the researchers showed the application activities on a computer screen and digitally distributed them to the students. For the first stage of the POE study, the "predict" step, the students were given sufficient time and asked to fill in the relevant section in the prepared leaflets. After this step, the "observation" phase started. During the observation phase, the researcher conducted the activity, and responded to all of the students' inquiries regarding it. Then, the last stage, the "explanation" step, was given to the students, and sufficient time was given to the students to fill in this section. Completed activity studies were presented to the researchers in three different formats by the students. While some students filled out the work in the digital environment and sent it, others took a printout of the activity at home and sent it by taking a photo of it after filling it in manually or writing it on a blank paper without taking a printout and sending it by taking a photo. In Figure 2, an example of an activity form prepared by the researchers (a) and an example of an activity-filled by students (b) are presented.

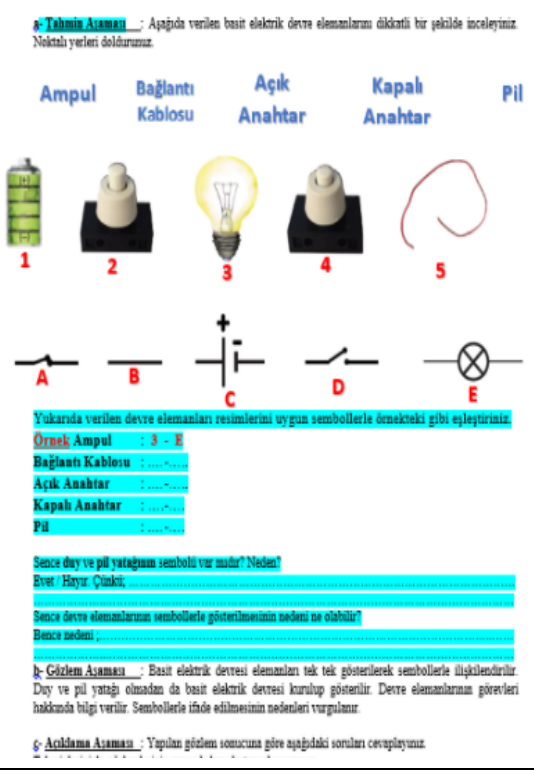
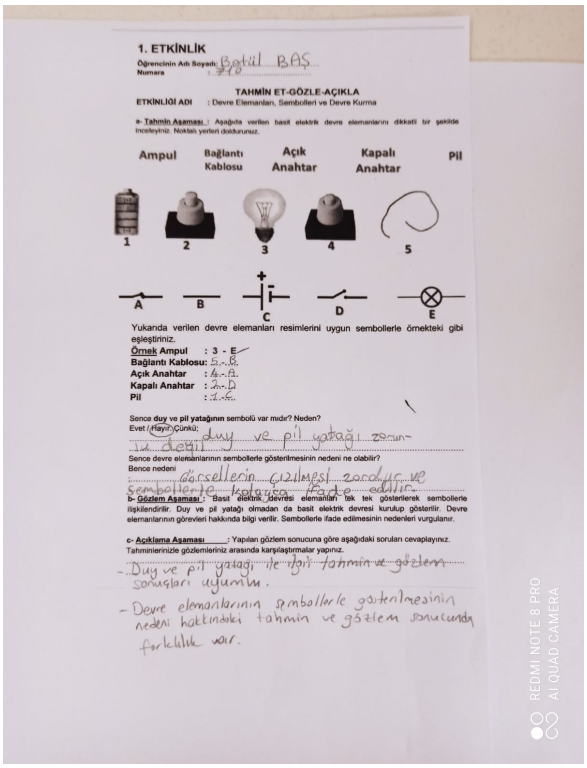
a) An example of an activity form prepared by the researchers	b) Activity form filled by the students
	

Figure 2. Sample of study activity prepared for POE application and sample filled by the students

3.4. Data Analysis

The study employed the SPSS package for statistical operations. The data was coded appropriately for the analyses made in the SPSS 20.0 program. The current study tested whether the data was normally distributed to analyze the data and identify the statistical techniques used in solving the sub-problems. Different statistical tests were used in the data analysis (Table 3). In order to use parametric tests, the data must meet assumptions such as sufficient sample, normal distribution, and equality of variances. They evaluated whether they met these

assumptions based on the descriptive statistical results of the study's data. The Shapiro-Wilk test was used to investigate the conformity of the scores obtained by the students to the normal distribution. The Shapiro-Wilk test is used to test the normality of the data distribution in studies with a small number of data (Karagöz, 2018). Non-parametric tests (Mann-Whitney U test and Wilcoxon Sign test) were used because the scores obtained from the electrical achievement test and the attitude scale towards science did not show a normal distribution as a result of the normal distribution test ($p=0.00<0.05$). The results obtained from the achievement test applied to the control and experimental groups as pretest and posttest were analyzed with the Mann-Whitney U test, and it was determined whether there was a statistically significant difference between the groups. The attitude scale towards scientific learning was applied to the experimental and control groups as a pretest and posttest, and samples related to the results were analyzed with the Mann-Whitney U Test. The comparison of the pretest and posttest scores of the attitude scale towards science lessons of the experimental and control groups in the study was carried out with the Wilcoxon sign test.

Table 3. Tests Used in The Analysis of The Research

RESEARCH	Mann-Whitney U	Wilcoxon Sign Test
Is there a significant difference in the results obtained from the academic achievement scores of the experimental and control groups?	✓	
Is there a statistically significant difference between the pretest and posttest scores of the experimental and control group students' attitudes towards science learning before and after the application?	✓	
Comparison of the pretest and posttest scores of the experimental and control groups' attitude scale towards science lesson		✓

3.5. Validity and Reliability

The Cronbach Alpha reliability coefficient of the scale, which was developed by Çallı (2019) and used to collect data on academic achievement in this study, was determined as 0.847 for the pretest and 0.908 for the posttest. The fact that the Cronbach Alpha reliability coefficient greater than 0.80 indicates a high level of reliability, and the Cronbach Alpha value between 0.60 and 0.70 demonstrated that the data obtained could also be reliable (Cronbach, 1951).

The Cronbach Alpha reliability coefficient of the scale, which was developed by Nuhoğlu (2008) as an attitude scale towards science learning, was determined as 0.8739.

4. Findings

In this section, statistical findings obtained from the data collected in the research are given.

4.1. Determining the Effect of POE Applications on Academic Achievement

Table 4 shows the results of the Shapiro-Wilk test, which was conducted to check the conformity of the scores obtained by the students in the experimental and control groups during the pretest and posttest stages of the achievement test to the normal distribution.

Table 4. Shapiro-Wilk Test Results of Electrical Achievement Test Pretest and Posttest Scores

Pretest / Posttest	Group	Statistics	p (significance)
Achievement test (Pretest)	Experimental group	0.915	0.010
	Control Group	0.924	0.013
Achievement test (Posttest)	Experimental group	0.873	0.001
	Control Group	0.914	0.009

Table 4 shows that the pretest and posttest scores of the achievement test were not normally distributed since they were $p<0.05$ at the 95% confidence level. Accordingly, it was decided to use nonparametric tests in the analysis of pretest and posttest scores. The results of the Mann-Whitney U test were performed to answer the first sub-problem of the study "Is there a statistically significant difference between the academic achievement test pretest and posttest scores of the experimental and control group students?" are presented in Table 5.

Table 5. Findings regarding the academic achievement test pretest posttest scores of the experimental and control group students

a	Groups	N	Average ± SD	Order Avg.	U	p
Achievement test	Experimental group	36	17.33±5.98	40.79	493.50	0.081
(Pretest)	Control Group	36	15.11±5.23	32.21		
Achievement test	Experimental group	36	23.42±6.13	42.79	424.00	0.011
(Posttest)	Control Group	36	20.31±6.09	30.28		

When examining Table, as a result of the analysis performed to examine the academic achievement test pretest scores of the students in the experimental and control groups, no statistically significant difference was found between the experimental and control groups at the 95% confidence level ($p>0.05$). When examining the posttest success scores of the experimental and control group students, a statistically significant difference was found at the 95% confidence level, and this difference was in favor of the experimental group ($p<0.05$). The results of the study showed that the achievement scores of both groups increased as a result of teaching based on POE strategy and teaching with traditional methods. However, there was more improvement in the group in which POE strategy-based instruction was given.

When examining literature studies, similar results were found. In a study conducted by Uyanik (2017) for the science course, there are findings that the POE method increases the permanence of learning and academic success in the science course. Looking at the results of POE research; POE has the most positive effect on "academic success (Yildiz, 2021). Hanımoğlu (2015) stated that in the studies they conducted with seventh grade students using the POE strategies, their students' academic progress increased more. In the studies carried out by Balaydin & Altınok (2018), using the POE method, findings were obtained that the learning was much more permanent and the success increased in the students in the experimental group compared to the students in the control group. Sreerekha (2016) reveals that the effects of using the POE method on the performance and success of the students participating in the chemistry course were positive, which were determined by the application of the achievement

test. In the study conducted by Tetik (2019) on the unit of states of matter, it was understood that there was an increase in the percentage of academic success in the groups using the POE method. Zakiyah et al. (2019) used the POE method in order to minimize students' misconceptions in the field of thermodynamics, and a significant increase in success was achieved with this method.

4.2. Determining the Effects of POE Applications on the Attitudes of the Students in the Experimental Group towards Science Learning

In order to answer the second sub-problem of the study, "Is there a statistically significant difference between the pretest and posttest scores of the experimental and control group students' attitudes towards science learning?", the Shapiro-Wilk test was performed and it was determined that the data obtained from the attitude scale did not show a normal distribution ($p<0.05$). For this reason, the Mann-Whitney U test was used for nonparametric data. The Mann-Whitney U results of the experimental and control groups in the study regarding the Attitude Towards Science Lesson pretest are shown in Table 6 and the posttest Mann-Whitney U results are shown in Table 7. In Table 6, there was no statistically significant difference at the 95% confidence level between the pretest scores of the Attitude towards Science Lesson Scale and sub-dimensions for the experimental and control groups ($p>0.05$). On the other hand, in Table 7, there was no statistically significant difference at 95% confidence level between the posttest scores for the experimental and control groups ($p>0.05$ Wilcoxon sign test was used to compare the pretest and posttest results obtained and the results are presented in Table 8.

Table 6. Table Caption Usage

Sub-Dimensions	Groups	N	Average ± SD	Order Avg	U	p
Science & Technology (S&T) Lesson	Experim.	36	2.69±0.37	36.18	636.50	0.889
	Control	36	2.65±0.47	36.82		
Learning and Using New Information	Experim.	36	2.88±0.24	37.81	601.00	0.502
	Control	36	2.83±0.28	35.19		
Success/Failure in S&T Course	Experim.	36	2.45±0.49	37.42	615.00	0.702
	Control	36	2.42±0.43	35.58		
Liking Activities in S&T Class	Experim.	36	2.69±0.32	33.01	522.50	0.137
	Control	36	2.78±0.31	39.99		
Feel the Need For Activities in S&T Class	Experim.	36	2.83±0.29	34.08	561.00	0.178
	Control	36	2.84±0.43	38.92		
Attitude Scale Towards Science Lesson	Experim.	36	2.71±0.24	35.51	612.50	0.688
	Control	36	2.72±0.28	37.49		

Table 7. Posttest Results of Attitude Scale Towards Science Lesson of Experimental and Control Groups

Sub-Dimensions	Groups	N	Average ± SD	Order Avg	U	p
Science & Technology (S&T) Lesson	Experim.	36	2.63±0.49	34.22	566.00	0.323
	Control	36	2.75±0.36	38.78		
Learning and Using New Information	Experim.	36	2.75±0.40	33.64	545.00	0.171
	Control	36	2.84±0.28	39.36		

Success/Failure in S&T Course	Experim.	36	2.51±0.50	35.50	612.00	0.670
	Control	36	2.56±0.49	37.50		
Liking Activities in S&T Class	Experim.	36	2.67±0.46	33.88	553.50	0.245
	Control	36	2.79±0.33	39.13		
Feel the Need For Activities in S&T Class	Experim.	36	2.81±0.38	34.17	564.00	0.182
	Control	36	2.87±0.38	38.83		
Attitude Scale Towards Science Lesson	Experim.	36	2.67±0.37	33.43	537.50	0.210
	Control	36	2.77±0.27	39.57		

Table 8. Attitude Towards Science Learning Scale Pretest and Posttest Results Comparisons

		N	Pretest		Posttest		Z	p
			Average ± SD	Order Avg	Average ± SD	Order Avg		
Science&Technology (S&T) Lesson	Experim	36	2.69±0.37	36.18	2.63±0.49	34.22	-0.576	0.565
	Control	36	2.65±0.47	36.82	2.75±0.36	38.78	-1.389	0.165
Learning and Using New Information	Experim	36	2.88±0.24	37.81	2.75±0.40	33.64	-1.704	0.088
	Control	36	2.83±0.28	35.19	2.84±0.28	39.36	-0.637	0.524
Success/Failure in S&T Course	Experim	36	2.45±0.49	37.42	2.51±0.50	35.50	-0.727	0.467
	Control	36	2.42±0.43	35.58	2.56±0.49	37.50	-2.310	0.021
Liking Activities in S&T Class	Experim	36	2.69±0.32	33.01	2.67±0.46	33.88	-0.199	0.842
	Control	36	2.78±0.31	39.99	2.79±0.33	39.13	-0.120	0.905
Feel the Need For Activities in S&T Class	Experim	36	2.83±0.29	34.08	2.81±0.38	34.17	-0.045	0.964
	Control	36	2.84±0.43	38.92	2.87±0.38	38.83	-0.420	0.674
Attitude Scale Towards Science Lesson	Experim	36	2.71±0.24	35.51	2.67±0.37	33.43	-0.157	0.875
	Control	36	2.72±0.28	37.49	2.77±0.27	39.57	-1.620	0.105

For the second research question, the statistical results of the research of the experimental and control group students' attitude scale pretest and posttest scores towards learning science are presented in Table 8. There was no statistically significant difference at the 95% confidence level between the pretest and posttest scores of the students in the experimental and control groups, except for the sub-dimension of "successful/unsuccessful in the science lesson" ($p>0.05$). There was no statistically significant difference at the 95% confidence level between the pretest and posttest scores of the Attitudes Towards Science Lesson Scale of the students in the experimental and control groups ($p>0.05$). Accordingly, the student's attitudes towards the science lesson, in general, are independent of the distance education and online POE strategy-based or traditional method. When studies on the relationship between POE strategy applications and attitude are examined in the literature, these studies were carried out in a face-to-face education environment and positive results were obtained between POE strategy applications and attitude. In the study conducted by İnce et al. (2016) using the POE strategy to explain the principles of physics, it was concluded that the students exhibited positive attitudes. Akarsu (2018) in his study using activities developed with the POE strategy in science teaching, found that students developed positive attitudes towards the lesson.

5. Discussion

The POE strategy, which helps students better understand the concepts, events, or phenomena to be taught, is an extremely advantageous technique used in teaching. This study concluded that POE applications performed online with distance education positively improved the academic success of the students, based on the findings obtained as a result of the application process. It is thought that the reasons for the increase in the academic success of the experimental group students even in the distance education process are the fact that the students answer all the questions asked in POE applications, prepare observation or experiment reports, and use their skills and prior knowledge when necessary. According to Akgün & Deryakulu (2007), in the POE technique, students experience a scientific contradiction while observing, and they must put forward their own ideas to overcome this contradiction. In this direction, POE activities enable students to work like scientists because activities prepared with the POE technique require using scientific process steps and scientific process skills. Apart from that, it enables students to explain them logically by establishing a bridge between their prior knowledge and newly learned information. In line with all these explanations, it is concluded that this technique is suitable for science lessons (Atasoy, 2004). A similar study was carried out with seventh-grade students with face-to-face training on simple electrical circuits of the unit "Electricity in Our Lives", and it was concluded that the POE teaching technique was more effective on the students' academic achievement than the traditional teaching method. Based on this result, POE applications have a positive effect on the academic success of students in face-to-face teaching and online teaching. When the literature is examined, the findings of this online study show parallelism with the findings of Balaydin & Altınok (2018); Erdem Özcan (2019); Göktürk (2015); Sreerekha (2016); Teerasong et al. (2010); Yildrim (2016); Zakiyah et al. (2019)

Among the reasons why POE applications increase attitudes towards science learning positively, it is seen that it provides students with individual learning, and increases their interest in the lesson. In addition, the fact that alternatives such as experimentation or observation can make abstract concepts and events concrete in practice makes the lesson fun. The studies in the literature were examined, and it was concluded that there was a positive increase in the attitudes of the students towards the lesson in the lessons taught face to face with the POE strategy (Akarsu, 2018; Bilen, 2009; Erdem Özcan, 2019; Göktürk, 2015; Keeratichamroen et al., 2007; Köseoğlu et al., 2014; Özsoy, 2020; Smith et al., 2010; Tao & Gunstone, 1999). Despite many studies in the literature proving the positive contributions of POE practices to academic achievement and attitude towards the course, it was stated that there was no statistically significant difference in academic achievement and attitude in Baladın-Duman (2019)'s study in which the fifth-grade 'Nutritional Contents and Digestive System' subjects were taught. In the study, which was carried out online during the pandemic process, the results were in line with Baladın-Duman (2019). Therefore, the student's attitudes towards the science lesson, in general, were independent of the online education, the POE strategy, or the traditional method.

6. Conclusion

This study concluded that online POE applications with distance education improved the students' academic achievement positively as in face-to-face education, but did not have any effect on the attitude. In other words, online education prevents the interaction that exists in the lessons conducted in the classroom in face-to-face education with students, and this situation causes no significant difference in attitude. Some students wrote under the activity sheet during the online POE process of science lessons: "I think this system has been better, and I hope it will continue like this. Thank you very much teacher for thinking of such a thing." This statement suggests that some students were positively affected by the method, but the duration of the application was not enough to make a significant difference in attitude.

Limitation

Since the research was carried out during the distance education process, the technical possibilities of the students and the suitability of the working environments constitute the limitations of the study.

Recommendation

Since distance education based on the POE strategy increases the academic success of the students in the science course, it can be recommended to prepare lesson plans in accordance with distance education in different education levels and different units.

Acknowledgments

This study was conducted based on the master's thesis titled "The Effect of Science Teaching Based on POE Strategy in the Distance Education Process on the Academic Achievement and Attitudes of Secondary School Students" completed by Mustafa ÖZKAN under the supervision of Assoc. Prof. Dr. Sevgül ÇALIŞ as a part of Bursa Uludağ University, Institute of Educational Sciences, Department of Mathematics and Science Education, Science Education Master's Program.

Conflict of Interest

The researchers declare that there is no conflict of interest.

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