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The Effect of Argumentation-Based Teaching on Scientific Process Skills of 7th Grade Students

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Abstract

The aim of this study is to investigate the effect of argumentation-based teaching carried out with secondary school 7th grade students on students' scientific process skills. The sample of the study consists of 7th grade students in two different branches studying at a public school in the Central Anatolia Region of Turkey in the 2018-2019 academic year. The study was carried out with the participation of 36 students, 18 in the experimental group and 18 in the control group, and lasted approximately 12 weeks. Mixed method was used as the research model in the study. In the quantitative part of the research, the semi-experimental pretest-posttest paired control group design was used, and in the qualitative part, the semi-structured interview form developed by the researcher was used. The "Scientific Process Skills Scale" was applied to the experimental and control groups as a pre-test and post-test. At the end of the process, the scores of the students from the related test were analyzed. As a result of the research, no significant difference was found between the scientific process skill levels of the experimental and control groups.

Keywords: argumentation, scientific process skills, 7th grade.

1. Introduction

In today's conditions, raising individuals who can compete actively in social and economic lanes is directly related to the competitive capacity of countries. This situation increases the need of countries for individuals with high problem-solving skills, responsible, decision-making skills, innovative and critical thinking. For this reason, raising literate individuals in many fields has become the main goal of the education system due to the need for strategies, methods and techniques that will provide the said educational output (Ministry of National Education [MoNE], 2018). In order to achieve this goal, the education programs have been updated and the scientific literacy vision emphasized by the education programs has reached a very important point (Özdem-Yılmaz, 2017). Scientifically literate individuals are defined as who in addition to having basic knowledge can question, solve problems, have scientific process skills, and think creatively and analytically (MoNE, 2015). What is expected from scientifically literate individuals is to use their skills in different environments and conditions and to develop arguments by making scientific explanations based on the data they have obtained (Peker, 2017). Argument is defined as a thesis or claim put forward with a justification (Kuhn, 1993). Argumentation, on the other hand, is a scientific discussion technique that requires skills such as justification, creating arguments and counter-arguments, and making inferences based on evidence (Özdem-Yılmaz,

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2017). Scientific debate, ie. argumentation, which has been very popular lately, is a part of science in any form. Therefore, it is very important to integrate it into education (Erduran & Jiménez-Aleixandre, 2007).

Argumentation-based education has become increasingly popular both in our country and in the world. Because argumentation not only provides students with content knowledge, but also enables them to become entrepreneurial, creative, social and questioning individuals who can express their ideas clearly. Argumentation enables individuals to be involved in the teaching process by questioning their own ideas and the ideas of others by using logical approaches (Uçar, 2018). In addition, argumentation is a method frequently used to refute or support claims in discussions that take place in daily life. Because argumentation leads to thinking, provides important contributions to issues such as generating ideas, defending one's ideas, and establishing healthy communication (Akbaş, 2017).

Argumentation is one of the most researched topics in science education in recent years. When the relevant literature is examined, many studies examining the effects of argumentation-based learning activities on individuals' academic achievement, attitudes towards science disciplines, and conceptual understanding have been found (Akdöner, 2019; Akyüz, 2018; Balcı, 2015; Cevger, 2018; Demirel, 2014; Gençoğlan, 2017; Tekeli, 2009). However, there are very few studies investigating the effects of argumentation-based practices on students' scientific process skills (Aslan, 2018; Demirel, 2014; Gençoğlan, 2017). Therefore, it is believed that this study will contribute to the field.

The aim of the research is to investigate the effect of argumentation-based teaching, carried out within the "Force and Energy" unit of the Science course, on the scientific process skills of 7th grade students. For this purpose, answers to the following questions were sought:

(1) Is there a statistically significant difference between the Scientific Process Skills pre-test scores of the experimental group in which argumentation-based activities were applied and the Science Process Skills pre-test scores of the control group in which the current program was applied?

(2) Is there a statistically significant difference between the Scientific Process Skills post-test scores of the experimental group in which argumentation-based activities were applied and the Scientific Process Skills post-test scores of the control group in which the current program was applied?

(3) Is there a statistically significant difference between the mean scores of the Scientific Process Skills Test before and after the application of the experimental group in which the argumentation-based activities were applied?

(4) What are the students' views on Argumentation-Based Teaching Activities?

2. Methods

Mixed method was used as a research model in the study titled The Effect of Argumentation-Based Teaching on 7th Grade Students' Scientific Process Skills. Mixed-method studies are studies in which quantitative and qualitative methods are used together in line with the principles of pragmatist philosophy in order to deal with the problem in a multidimensional and comprehensive way (Yıldırım & Şimşek, 2016). In the quantitative dimension of the study, a quasi-experimental pretest-posttest paired control group design was used. In this design, where unbiased assignment is not used, ready groups are paired over certain variables. Matching does not guarantee that the groups participating in the study are equivalent, but it is an important

alternative method in cases where random assignment cannot be made (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2013). Since the groups were selected from the existing classes in the study, it was decided that the quasi-experimental pretest-posttest paired control group design was the most appropriate design.

Another name for the quasi-experimental pretest-posttest paired control group design that can be encountered in the literature is the unequalized control group quasi-trial model. Quasi-trial models are used when real-trial models are not available. The unequalized control group model is similar to the pretest-posttest control group model, but the difference is that unbiased assignment is not made in the formation of the groups. In the assignment of groups as experimental and control groups, an unbiased assignment is made. We can summarize the model as follows (G: Group, M: Measurement, X: Process) (Karasar, 2016):

$G_{experimental}$	$O_{1.1}$	X	$O_{1.2}$
$G_{control}$	$O_{2.1}$		$O_{2.2}$

Figure 1. Model, symbolic view with unsynchronized control group (Karasar, 2016)

In the qualitative part of the study, the interview technique was applied by using a semi-structured interview form developed by the researcher. The opinions of the students in the experimental group about the teaching activities used in the process were determined. The obtained data were analyzed by content analysis method. Content analysis is the analysis that aims to reach concepts and relationships that can explain the collected data. For this purpose, in content analysis, similar data are brought together within the framework of certain themes and concepts, organized and interpreted in a way that the reader can understand (Yıldırım & Şimşek, 2016).

At the beginning of the research process, the Scientific Process Skills Scale (SPS) was applied to the experimental and control groups as a pre-test. In the process, first of all, general information and exercises about argumentation were given to the experimental group. The experimental group was taught within the scope of the "Force and Movement" unit with argumentation-based teaching activities for about 12 weeks. At the end of the process, SPS, which was applied as a pre-test, was applied as a post-test. In the control group, the "Force and Motion" unit was taught by applying the current program and adhering to the textbook, and at the end of the process, SPS was applied as a post-test.

2.1 *Study group*

The study was conducted with 36 7th grade students studying at a public school in the Central Anatolia Region of Turkey in the 2018-2019 academic year. Students study in 7/A and 7/C branches. In the study, the 7/A branch consisting of 18 people was assigned as the experimental group, and the 7/C branch consisting of 18 people was assigned as the control group. The researcher conducted the Science courses of both branches. Of the 18 students in the experimental group, 12 were girls and 6 were boys. Of the 18 students in the control group, 10 were girls and 8 were boys.

The school where the experimental and control group students' study is a school which is active in sports and cultural terms and trains students for high-quality high schools. The classes in which the student's study have the same physical equipment. There are no smart boards in either classroom. When visual elements are used, a projection is brought to the classroom or a lesson is taught in the laboratory. Parents of students are parents who attach importance to the education of their children and are in contact with the school. It can be said that the economic conditions of the students are moderate. There is no big difference between students in terms of economy. Considering the education levels of the parents, it can be said that they have been educated at least at primary school and at most at high school level.

2.2 *Data collection tool*

Scientific process skills scale

In the study, the Scientific Process Skills Scale developed by Aydoğdu, Yıldız, Buldur, and Tatar (2012) was used to measure students' scientific process skills. The scale consists of 27 items, all of which are multiple choice. The reliability coefficient KR-20 of the scale was determined as 0.84. The difficulty value of the scale is 0.54. The distinctiveness index of 27% was calculated between the scores of the upper and lower groups and it was determined that all items in the scale were statistically distinctive ($p<0.05$). The scale is suitable for measuring the scientific process skills of 6th, 7th and 8th grade students (Aydoğdu, Yıldız, Buldur & Tatar, 2012)

Interview form

In the study, an interview form consisting of semi-structured interview questions prepared by the researcher was used to get the opinions of the experimental group students about the implementation process. In order to ensure the sufficiency of the questions, the opinions of three science teachers were taken, the questions were arranged in line with the opinions, and the form was finalized by taking the opinion of the advisor.

2.3 *Data collection and analysis*

In the study, the Scientific Process Skills Scale was used to collect quantitative data. The scale was applied to the experimental and control groups as a pre-test before the application and as a post-test after the application, and the quantitative data obtained were analyzed with statistical methods. In order to collect qualitative data, interview questions developed by the researcher were used. The analysis of qualitative data was made by content analysis method.

Quantitative data obtained during the study process were transferred to the computer environment and appropriate statistical methods were used to determine the relationships between the variables. While the experimental and control groups were compared according to their scale scores, the t-test for independent samples was performed on the data exhibiting normal distribution. When a statistically significant difference was detected between the pretest scores of the experimental and control groups, ANCOVA was used to eliminate the effect of the pretest in order to compare the posttest scores. In order to compare the posttest-pretest difference scores within the group, the Dependent Samples t-test was used if the data were normally distributed.

The Shapiro-Wilks test was used to examine the conformity of the data to the normal distribution, since the experimental and control groups each consisted of 18 people. Shapiro-Wilks test results of the groups are presented in Tables 1 and 2.

Table 1. Shapiro-Wilks test findings regarding the normal distribution of the groups

Scale	Test	Group	N	p
Scientific Process Skills (SPS)	Pre-Test	Experimental Group	18	0.062
		Control Group	18	0.222
	Post-Test	Experimental Group	18	0.309
		Control Group	18	0.056

Table 2. Shapiro-Wilks findings regarding the posttest-pretest difference scores of the students

Test	Group	N	P
Scientific Process Skills (SPS)	Experimental Group	18	0.315

When Table 1 is examined, it is seen that the SPS test pre-test and post-test scores are in accordance with the normal distribution ($p>0.05$).

When Table 2 is examined, it is seen that the difference scores of the experimental group students are in accordance with the normal distribution (p>0.05).

The analysis of qualitative data was carried out with the content analysis method. The data obtained from the interview with the experimental group students at the end of the process were first transferred to the computer environment. The answers of the students were examined one by one and codes were given by dividing them into meaningful sections. All codes were brought together and examined, common points between the codes were determined and themes were created. Thus, the answers were categorized in a more general framework by establishing meaningful relationships. After the themes were determined, the frequency and percentage values of the themes were calculated, so it was ensured that numerical data were used when talking about student opinions.

2.4 *Preparation of worksheets*

The worksheets were prepared by the researcher adhering to the achievements in the 7th Grade Science Curriculum (MoNE, 2018). During the preparation process, studies and books related to the subject of argumentation were examined, and the prepared worksheets were used after the examination of two experts. The activities were planned in a way that allows students to discuss. Activities such as expression table, use of evidence, concept cartoon, competing theories, which are among the argumentation techniques, were used.

2.5 *Teaching process*

The teaching process was carried out with the control group throughout the unit "Force and Energy" with the current program and the activities suggested in the textbook. In the experimental group, the following activities and practices were carried out.

Before starting to implement the argumentation-based teaching activities, small preparatory activities were carried out for the experimental group. Thus, the students had a general knowledge about creating arguments. In the implementation process of the activities, science classrooms and science laboratory were used. During the activities, the students worked in groups or individually, depending on the status of the content. However, even if they work in groups, it was ensured that each student had worksheets. The students were allowed to discuss and present their ideas in the process or to refute the ideas they disagreed with, and the researcher only took the role of a guide. A 1-week example of the teaching process has been given below.

At week 10 "The Power of Air" activity, which is related to the achievement of "F.7.3.3.3. A means of reducing the effect of air or water resistance is designed" has been carried out. Students were given a story and a claim made in the story. Students were asked to explain whether they agreed with this claim by providing reasons, supporters and rebuttals. After the class discussion, the students were asked to design an experiment in groups about their claims and to transfer their observations to the worksheets. The results were discussed. 4 class hours were allocated for this activity.

3. Findings

In this part of the research, in which the effect of argumentation-based teaching on the scientific process skills of 7th grade students is examined, the findings and comments obtained as a result of the analyzes of the sub-problems are included.

In the first sub-problem of the study, "Is there a statistically significant difference between the PPS pre-test scores of the experimental group in which the argument-based activities were applied and the PSB pre-test scores of the control group in which the current program was applied?" Analyzes made to solve the problem are discussed. In Table 3, the t-test results for the comparison of the PPS pre-tests of the experimental and control groups are given.

Table 3. Comparison of the SPS pre-test scores of the experimental and control groups

Groups	N	$\bar{X}$	S	sd	t	p
Experimental Group	18	15.944	3.90282	34	4.135	0.000
Control Group	18	10.444	4.07607			

BSB pre-test mean scores of the experimental and control groups were compared with the t-test for unrelated samples. When Table 3 is examined, it is observed that the PPS pre-test mean scores of the experimental group (=15.944) in which the argumentation-based teaching activities were applied were significantly different from the control group (=10.444) in which the current program was applied [$t_{34}=4.135$, $p<0.05$].

In the second sub-problem of the study, is there a statistically significant difference between the PPS Test post-test scores of the experimental group in which the argumentation-based activities were applied and the PPS Test post-test scores of the control group in which the current program was applied? Analyzes made to solve the problem are discussed. When Table 2 is examined, it is observed that the difference between the PSD pre-test scores of the groups is significant. For this reason, the effect of BSB pre-test scores should be eliminated in order to make PPS post-test comparisons of the groups. For this purpose, ANCOVA (Covariance Analysis) method was preferred to investigate the relationship between the post-test scores of the groups. Analysis results are as in Table 4.

Table 4. Comparison of SPS post-test scores of experimental and control groups

Source of Variance	Sum of Squares	sd	Mean of squares	F	Significance Level (p)
Regression	339.678	1	339.678	25.112	0.000
Group	5.082	1	5.082	0.376	0.544
Error	446.377	33	13.527		
Total (Corrected)	1036.750	35			

When Table 4 is examined, no significant difference was found between the mean PSD post-test scores adjusted according to the SPS pre-test scores of the experimental and control groups [$F_{(1-33)}=4.211$, $p>0.05$]. In the case that the SPS pre-test scores are kept under control, the PPS post-test mean score of the experimental group (=15.877) does not statistically differ significantly from the PSS post-test mean score of the control group (=14.956). In other words, applications based on scientific argumentation did not have any effect on students' scientific process skills.

In the third sub-problem of the study, is there a statistically significant difference between the mean scores of the SPS test before and after the application of the experimental group in which the argumentation-based activities were applied? Analyzes made to solve the problem are discussed. Provided that the data are obtained from the same source and distributed normally,

the statistical method that can be used to examine whether there is a statistically significant difference between the means of two consecutive measurements is the Paired Samples t-test (Can, 2017). Dependent samples t test results are as follows in Table 5.

Table 5. Dependent samples t-test for comparison of SPS pre-test-post-test scores within the group

Measurement	N	$\bar{X}$	S	sd	t	p
Pre-Test	18	15.9444	3.90	17	3.146	0.006
Post-Test	18	18.0556	5.11			

When Table 5 is examined, a statistically significant difference was found between the mean score of the PPS test performed before the activity (pretest=15.9444) and the mean score of the PPS test performed after the activity (posttest=18.0556) in the experimental group in which the argumentation-based activities were performed [$t(17)=3.146$, $p<0.05$]. In other words, argumentation-based activities caused a significant increase in the scientific process skills of the experimental group students.

In the fourth sub-problem of the research, an answer to the question "What are the opinions of the experimental group students about argumentation-based teaching activities?" was sought. The students' opinions were transferred to the computer environment and their answers were expressed with codes. Themes were created by combining similar codes. The themes are presented in Table 6 along with their frequency and percentage values. Apart from the numerical data, students' opinions were also included, but the names of the students were not specified. They were expressed as Ö1, Ö2, Ö3 ..... Ö18.

Table 6. Students' views on argumentation-based teaching activities

Scale Item	Theme	Frequency (f)	Percent (%)
What would you like to say about the activities held within the scope of the "Force and Energy" unit?	Fun/Beautiful	16	47.1
	Instructive/Formative	8	23.5
	Hard	5	14.7
	Boring	3	8.8
	Different	2	5.9
Did you enjoy the activities held within the scope of the "Force and Energy" unit? Which parts did you like the most? If you didn't like it, can you explain why you don't like it?	I liked experimenting	17	50.0
	I didn't like filling out worksheets	10	29.4
	I didn't like in-group conflicts	3	8.8
	There is nothing I don't like	2	5.9
	I liked doing group work	1	2.9
	I didn't like that it was tiring	1	2.9
What did you learn in the course of activity?	I learned to make arguments	14	56.0
	I learned designing experiments	8	32.0
	I reinforced what I learned	3	12.0
Did you have any difficulties during the applications? What are these parts?	Filling out worksheets	7	35.0
	Make an argument	7	35.0
	Experiment Process	4	20.0
	Working with a group	1	5.0
	I had no difficulty	1	5.0

Would you like to have similar activities in other units and other lessons?	Only suitable to Science classes	6	28.6
	Applicable to all subjects	4	19.0
	May be in social studies class	3	14.3
	May be in other units in science class	2	9.5
	May be in Turkish classes	2	9.5
	Not wanted	2	9.5
	May be in Maths	1	4.8
	May be in English	1	4.8
What are your suggestions/opinions regarding the implementation of the activities?	Worksheets should not be used	8	36.4
	More experiments should be done	5	22.7
	Good this way	4	18.2
	Studies should be individual	2	9.1
	Students should specify the groups	1	4.5
	Activities are time consuming	1	4.5
	Activities are hard	1	4.5

Experimental group students were asked about their thoughts on argumentation-based teaching activities. Nearly half of the students' opinions are that the activities are fun/beautiful. The frequency distribution and percentage values of the opinions are shown in Table 6. Among examples of student opinions are "...we did experiments and put them on paper, so we developed our power of interpretation and thus we learned something" (S11), "...the process went well, we learned new things, we used information and words that we did not use before, such as data assertions" (T12), "...it was very nice, I had fun, it was different" (T14), "...it was very nice, very entertaining" (T2).

Students were asked whether they liked or disliked things during the implementation of the activities. The data of student answers are presented in Table 6. Half of the opinions are that students like to experiment in the process. In addition, approximately 30% of student opinions state that students do not like to fill out worksheets. Sample student opinions are as follows: "...I liked doing experiments but I did not like writing" (S5), "...I liked it, it was good. I liked experimenting. I didn't like working in a group because some of my friends just found their ideas right" (T1), "...it was nice. I enjoyed experimenting and doing group work. I did not like to fill in the worksheets" (S7).

Students were asked what they learned during the activities. Students generally stated that they learned how to construct arguments and design experiments (Table 6). Some examples of the students' views are as follows: "...I learned the data, the claim, the justification, the supporter, I learned how to design an experiment" (S3), "... We experimented in many different ways, and we made claims with the data we obtained from our experiments" (T8), "...I understood the dependent and independent variable well. I learned to make arguments" (T6).

The students were asked whether there were any difficulties they encountered during the applications, and if so, what these difficulties were. Most of the students stated that they had difficulty in recording their ideas on the worksheets after the discussion process (Table 6). In addition, they stated that they had difficulties in the argumentation process and in the experiment design process. The following examples can be given to students' views: "...I had difficulty in filling out the worksheets, that is, I had difficulty in writing" (S3), "...I had difficulty in finding dependent and independent variables, others were easy" (S4), "...I had difficulty in making arguments at first" (S9), "... it was a little difficult to write" (T16).

The students were asked whether they wanted similar activities to be implemented in other units or other courses in the science lesson. Most of the students stated that argumentation-based activities are only suitable for science lessons. Some of them stated that they would like to have similar activities in all courses. Again, in different courses, there were students who expressed their desire to implement argumentation-based activities for different reasons. Frequency and percentage values of student opinions are given in Table 6. Sample student opinions are as follows: "…it can be in all courses if it is experimented. No writing" (S5), "…it could have been in the solar system unit in the science class. I would like it to be used in social studies as well because it is more suitable for discussion" (S7), "…I would like it to be in social studies because social studies is difficult because maybe it can be better with such activities" (S10), "…it may be in science, but I am not sure in other classes, it will be a little different in those classes than in science. I wish it was only in science" (T12).

Students were asked about their thoughts and suggestions about the implementation of argumentation-based teaching activities. Most of the students stated that the worksheets should not be used during the activities. Some of the students also stated that more experiments should be done (Table 6). Sample student opinions are as follows: "…it would be better if we did more experiments. They were good but difficult activities, they took a little longer" (T4), "…it would be better if we determined the groups with the people we chose" (T6), "…it was good. It would be better without the worksheets" (T8), "…it would be better if the writing part was less. Working individually could be better because there are conflicts within the group, sometimes they do not listen to each other and act independently. Sometimes the job is left to one person and others are not interested" (T12), "…it would be better if we did more experiments" (T15), "…the implementation of the activities was good. Working in a group was not good, it would be better if it was individual" (T16).

4. Discussion and conclusions

In this section the results related to the problem "Within the scope of the Force and Energy unit of the 7th grade Science course, is there a significant difference between the scientific process skills of the experimental group taught with argumentation-based activities and the control group taught with the current program?" are mentioned.

A significant difference was found between the pretest scores of the Scientific Process Skills Test (SPS), which was carried out before the application in order to measure the scientific process skills of the experimental and control groups. In order to investigate whether there is a significant difference between the PPS post-test scores of the experimental and control groups after the application, the effect of the PPS pre-test scores was removed by statistical methods and analyzed. It was observed that the PPS post-test scores of the experimental and control groups were not statistically significant when the effect of the PPS pre-test was eliminated. Accordingly, argumentation-based teaching activities do not have any effect on students' scientific process skills. The study conducted by Aslan (2018) with 29 secondary school 7th grade students, in which the pretest-posttest control group design was used, also indicates similar results. Argumentation activities were carried out within the scope of the Electric Energy unit of the Science course, and at the end of the process, no statistically significant difference was found between the experimental group and the control group in terms of scientific process skills. In addition, similar results were obtained in the study conducted by Gençoğlan (2017). Gençoğlan (2017), in his semi-experimental study conducted with 69 middle school 8th grade students, taught with the experimental group using argumentation-based teaching methods, while the control group was taught by following the current program and adhering to the textbook. At the end of the seven-week applications, the post-test scores of the experimental and control groups were compared and it was seen that there was no significant difference between the groups in terms of scientific process skills. In addition, the

results of the research contradict the results of the study conducted by Öç (2019). Öç, in his study designed as a quasi-experimental design with 82 pre-service science teachers, observed that scientific process skills increased in the experimental group in which argumentation-based laboratory activities were performed. In addition, the results of the research contradict with the results of the studies conducted by Demirel (2014), Cin (2013), Şekerci (2013), and Çınar (2013).

In addition to the comparison of the experimental and control groups in terms of scientific process skills, the experimental group to which the application was made was also compared within itself in terms of scientific process skills. The pretest scores of the experimental group from the PPS test were compared with the posttest scores, and it was determined that there was a significant difference in favor of the posttest scores. In other words, argumentation-based teaching activities led to an increase in the scientific process skills of the experimental group. However, this increase did not cause a statistically significant difference when compared to the control group. As a result of his study, Aslan (2010) concluded that there was a significant difference between the scientific process skills learning test pre-test and post-test scores of the experimental group students to whom the scientific discussion-oriented teaching approach was applied. Likewise, Erol (2010), in his research, observed that when he examined the pre-test and post-test scores of the experimental group students, their scientific process skills increased compared to the pre-application. Richmond and Striley (1996) found that discussions in their study caused positive changes in students' research skills necessary to conduct scientific research.

According to the results of the content analysis performed on the qualitative data, the students found the argumentation-based teaching activities entertaining, instructive and improving. In Kaya's (2005) interviews with students about the effectiveness of the argumentation model, the students stated that the activities carried out within the scope of the argumentation discussion model are more meaningful and permanent. Aktamış and Atmaca (2016), on the other hand, stated in their study that almost all of the pre-service teachers were satisfied with the argumentation-based activities, that this method positively affected the attitude towards the lesson and increased permanence. The thing that the students liked the most in the process was that they experimented and designed the experiment process by themselves. As a result of their study Tümay and Köseoğlu (2010); stated that argumentation-oriented teaching enables students to participate actively in the lesson, creates meaningful learning, and improves their thinking and questioning skills. While offering suggestions about the implementation process of the activities, the majority of them stated that more experiments should be done in the process. During the implementation of the activities, the students stated that they did not like to fill the worksheets the most. They stated that they did not have any difficulties in expressing their ideas orally, but they had difficulties when they had to express them in writing. While some of the students stated that they liked group work, some of them stated that they did not like in-group conflicts and miscommunication. The students expressed their opinion that they want similar activities to be implemented in all courses, especially in the science course. When the literature is examined, in the studies conducted with students at different education levels, as a result of using the argumentation-based learning approach in the lessons or including it in the course with various activities; It was determined that the participation in the course increased, permanent learning took place, the subjects covered in the course were learned in more detail, and it gave students the skills of inquiry, problem solving, and thinking (Kabataş Memiş, 2014; Günel, Kıngır & Geban, 2012; Üstünkaya & Savran-Gencer, 2012).

Considering the results of this study, which examines the effects of argumentation-based teaching activities on students' scientific process skills, the following suggestions can be made:

(1) The study was carried out with 36 students for 12 weeks within the scope of the Force and Energy unit of the 7th grade science course. Similar studies can be carried out at different

grade levels, in other courses other than Science, or in different units in the Science course. In addition, the study can be repeated by studying for a longer time with a larger sample.

(2) In the study, the effect of argumentation-based teaching activities on students' scientific process skills was investigated. The study can be repeated with different independent variables other than scientific process skills.

(3) In the study, the effectiveness of the teaching based on the current curriculum and the textbook and the argumentation-based teaching were compared. In future studies, argumentation-based teaching and different teaching methods and techniques can be compared.

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