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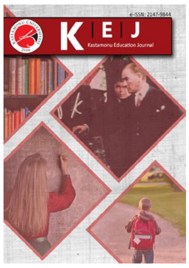

| Research Article / Araştırma Makalesi |

The Effect of Argumentatıon Modal Implemented in The Unit "Change of Matter" on Students' Achievements, Argumentative Attitude, Perceptions of Problem Solving

"Maddenin Değişimi" Ünitesinde Uygulanan Argümantasyon Modelinin Öğrencilerin Başarılarına, Tartışmacı Tutumlarına, Problem Çözme Algılarına Etkisi[1]

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Keywords

1. Maddenin değişimi
2. Argümantasyon
3. Başarı
4. Tartışmacı tutum
5. Problem çözme algısı

Anahtar Kelimeler

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Abstract

The study aims to investigate the effect of using the argumentation model in the "Change of Matter" unit in the 5th grade Science course on students' science achievement, argumentative attitudes and problem solving perceptions. The study group was selected with the convinience sampling method and a secondary school in Defne/ Hatay, and the experimental group consisting of 35 students and the control groups consisting of 33 students were determined by random assignment. At research used pretest- posttest nonequalized control group quasi- experimental design. Data collected by "Change of Matter Achievement Test" prepared by reseacher, "Arguer Attitude Scale" adapted by Kaya and Kılıç (2008) and "Problem Solving Inventory" adapted by Şahin, Şahin and Heppner (1993) and Taylan, (1990). Data analysis by using SPSS packet programme, benefit from descriptive and inferental statistic method. Lessons performed the activities of recommended by the Ministry of National Education (2013) in control group and argumentation activities in experimental group. After appliying pretests, lessons started at the same time in both groups and aplication continued 20 hours (5 weeks). After aplication the same tests applying as posttests. In conclusion ABSL (Argumentation Based Science Learning) method didn't creat statistically significant different as far as present programme in academic success and problem solving skills sense; besides determined effected positively to argumentative skills sense.

Öz

Çalışma, argümantasyon modelinin 5. Sınıf Fen Bilimleri dersindeki "Maddenin Değişimi" ünitesinde kullanımının öğrencilerin fen başarılarına, tartışmacı tutumlarına ve problem çözme algılarına etkisinin incelenmesini amaçlamaktadır. Çalışma grubu uygun örnekleme yöntemiyle Hatay ili Defne ilçesindeki bir ortaokul seçilerek, 35 öğrenciden oluşan deney ve 33 öğrenciden oluşan kontrol grupları yansız atama yoluyla belirlenmiştir. Çalışmada ön test- son test eşitlenmemiş kontrol gruplu yarı deneysel desen kullanılmıştır. Veri toplama aracı olarak araştırmacı tarafından hazırlanan "Maddenin Değişimi Ünitesi Başarı Testi", Kaya ve Kılıç (2008) tarafından uyarlanan "Tartışmacı Tutum Ölçeği" ve Şahin, Şahin ve Heppner (1993) ve Taylan, (1990) tarafından uyarlanan "Problem Çözme Envanteri" kullanılmıştır. Verilerin analizinde SPSS paket programı kullanılarak betimsel ve çıkarımsal istatistik yöntemlerinden yararlanılmıştır. Çalışmanın kontrol grubunda dersler MEB (2013)'in önerdiği Fen Bilimleri öğretim programına göre işlenirken deney grubunda argümantasyon modeline uygun hazırlanan etkinlikler kullanılarak işlenmiştir. Ön testler uygulandıktan sonra her iki grupta çalışma aynı zamanda başlanmış ve uygulama 20 saat (5 hafta) sürmüştür. Uygulama sonunda aynı testler son test olarak uygulanmıştır. Sonuçta argümantasyon modelinin mevcut programa göre akademik başarıda ve problem çözme becerileri algılarında istatistiksel olarak anlamlı bir farklılık oluşturmadığı, fakat öğrencilerin tartışmacı tutumlarını olumlu yönde değiştirdiği tespit edilmiştir

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INTRODUCTION

The modern scientific world emphasizes that scientific knowledge is a body of knowledge that is actively structured by scientists and argues that facts are not just the whole. In other words, scientists focus on how and why something happens rather than what knowledge is. With these questions, which form the basis of the constructivist approach, it is aimed to develop students' skills of questioning, scientific reasoning, decision making and expressing themselves effectively. As stated in the Ministry of National Education (2018), the constructivist approach requires; It is an activity that provides social interaction, to create the necessary learning environments for students to be active in the learning process, to ensure their active participation, to construct knowledge in the scientific process, to develop analytical thinking and decision-making skills. It is stated that discussion methods have an important place in fulfilling the stated requirements of the constructivist approach (Güneş, 2012; Kardaş, 2013; Seferoğlu & Akbıyık, 2006). The scientific discussion model, which is based on the constructivist approach and its practices in the field of learning, and which is based on active learning, is the argumentation model. Understanding science with the argumentation model is an approach that is gaining increasing attention. Argumentation applied in scientific discourse includes justifying claims, constructing counter-claims, presenting evidence, discussing and presenting data and theories in a social setting (Sadler & Fowler, 2006). Based on this view, argumentation, which is an important part of the construction of scientific knowledge, is a fundamental practice of science. Therefore, argumentation is considered as a practice that directs students to develop their understanding of science. Particularly, it will be ensured that students participate in the epistemic practice of science by participating in the discussion, which has an important place in the development of the skills of inquiry, scientific reasoning, decision making and expressing themselves effectively (Güneş, 2012; Kardaş, 2013; Seferoğlu & Akbıyık, 2006).

Although the argumentation model is suitable for the constructivist approach and the Science curriculum organized in 2018, the number of studies conducted in primary education is insufficient (Chen, 2011). When the results obtained from the study organized with the argumentation activities conducted by Chen (2011) were evaluated, it was seen that the students were able to develop more complex understanding, share their ideas with their peers, engage in more complex scientific processes, and take responsibility for their scientific learning as a result of the argumentation practices in the fifth grade. Based on this, it is thought that it would be beneficial to introduce students to the argumentation model at an early age. Because it is thought that this way, students can develop their inquiry skills, bring rational solutions to the problems they encounter in daily life, and develop decision-making skills (Chen, 2011). Argumentation practices provide students with the opportunity to identify the strengths and weaknesses of their understanding and enable students to participate in the organization of their thinking as well as the comparison and reconciliation of different rational accounts when they try to persuade others in scientific discourse (McNeill, Lizotte, & Krajcik, 2006). In this context, the importance of meeting the students with Science and the scientific method at an early age was realized, and the curriculum was changed and the Science course, which was taught in a limited way depending on the Life Studies course content in the 3rd grades of primary school, has been offered as a separate course since the 2014-2015 academic year started to appear in schools. The main purpose of the Science Curriculum is to raise scientifically literate individuals who have research-inquiry skills, can make effective decisions, can solve problems, are self-confident, can cooperate, communicate effectively, and learn lifelong with the awareness of sustainable development (MEB, 2013).

The Science Curriculum, which adopts a holistic approach in terms of learning-teaching theory and practices; In general, the inquiry-based learning strategy, in which the student is responsible for their own learning and actively participates in the learning process, is primarily and frequently used (MEB, 2013). The argumentation model included in this strategy is included in the 2013 Science Curriculum and its effectiveness has been widely researched in recent years (Arlı, 2014; Aslan, 2010; Bilir et al., 2020; Demirbağ, 2011; Demirbağ & Günel, 2014; Demirci, 2008; Domaç). , 2011; Erdoğan, 2010; Eroğlu and Yıldırım, 2020; Gültepe, 2011; Günel, Kıngır and Geban, 2012; Hacıoğlu, 2011; Kabataş-Memiş, 2011; Kara, Yılmaz and Kıngır, 2020; Küçük, 2012; Okumuş, 2012 ; Okumuş and Ünal, 2012; Soysal, 2012; Tekeli, 2009; Uluay, 2012; Uluçınar-Sağır, 2008; Uluçınar-Sağır and Kılıç, 2013; Yalçın-Çelik, 2010; Yıldırım, 2020). While argumentation is used in the educational environment, the student has the tasks like both defending his own argument to the other party in a reassuring way and expressing the weaknesses of the argument of the other party (Kuhn, 2009). For these purposes, the use of the argumentation model creates an environment where there is no winner or loser, it is not aimed to find the absolute truth, relations are established between thoughts, and an argumentative attitude can be developed in students instead of quarrel (Aymen-Peker, Apaydın, & Taş, 2012). In the classroom environment where argumentation is used, students defend their claims about a subject or use scientific theories, data and evidence to refute (Kaya, Çetin, & Erduran, 2014, Kabataş-Memiş, 2017). Argumentation, which is also defined as grounding scientific knowledge, is an argumentation model that consists of six elements proposed by Toulmin. While the basic elements that make up the skeleton of the argumentation model are data, claim, justification and support; limiters and rebuttals are auxiliary elements (Toulmin, 2003). However, there are differences in the literature in terms of the implementation of the model and the creation of activities (Arlı, 2014; Küçük, 2012; Okumuş, 2012; Okumuş & Ünal, Özer, 2009; 2012; Tekeli, 2009).

It has been determined that studies on argumentation are generally aimed at secondary school 7th and 8th grade and high school students or teacher candidates (Arlı, 2014; Aslan, 2010; Demirbağ, 2011; Demirbağ & Günel, 2014; Demirci, 2008; Domaç, 2011; Gültepe, 2011; Günel, Kıngır and Geban, 2012; Hacıoğlu, 2011; Kabataş-Memiş, 2011; Kutluca, Çetin and Doğan, 2014; Küçük, 2012; Okumuş, 2012; Okumuş and Ünal, 2012; Soysal, 2012; Tekeli, 2009; Uluay, 2012; Uluçınar-Sağır, 2008; Uluçınar-Sağır and Kılıç, 2013; Yalçın-Çelik, 2010). There are few studies based on argumentation for the fifth grade (Ceylan, 2012; Chen, 2011; Erdoğan, 2010; Kardaş, 2013; Taşpınar, 2011). However, as stated before, this study was carried out on 5th grade students, since it is thought that it is important for students to encounter the discussion environment at an early age in terms of using the model effectively and applying it to their daily lives.

In this study, it was aimed to determine the effect of teaching the " Change of Matter " unit of secondary school 5th grade Science course with argumentation activities on students' academic success, their argumentative attitudes that help students to learn meaningfully, and their perception of problem solving skills, which are indicators of science literacy.

METHOD

In the research, a quasi-experimental design with unequal pretest-posttest control group, which is one of the quantitative research methods, was used (Fraenkel, Wallen, & Hyun, 2012). The quasi-experimental design requires the unbiased assignment of two participant groups (one as the experimental group and the other as the control group). Although the pre-test and post-test were applied to both groups, the practice whose effectiveness will be examined is applied only to the experimental group (Creswell & Creswell, 2017). The pretest-posttest unequalized quasi-experimental design with the control group used in the study is given in Table 1.

Table 1. Pretest-posttest unequal quasi-experimental design with control group

	Pretest	Process	Posttest
AG	Change of Matter Achievement Test Argumentative Attitude Scale Problem Solving Inventory	Argumentation Model	Change of Matter Achievement Test Argumentative Attitude Scale Problem Solving Inventory
EPAG	Change of Matter Achievement Test Argumentative Attitude Scale Problem Solving Inventory	Methods Suggested by the Current Program	Change of Matter Achievement Test Argumentative Attitude Scale Problem Solving Inventory

Study Group

The study group consists of 5th grade students in two separate classes in a secondary school selected by convenient sampling method from secondary schools in Defne district of Hatay province. One of these classes was determined as the experimental group (N=35) and the other as the control group (N=33) by impartial assignment.

Data Collection Tools

The data collection tools of the study are the Change of Matter Achievement Test (CMAT) , the Argumentative Attitude Scale (AAS), and the Problem Solving Inventory (PSI).

Change of Matter Achievement Test (CMAT)

In the development of the Change of Matter Achievement Test, a total of 26 open-ended questions were prepared by the researcher, including 6 achievements of the relevant unit and 4 or 5 questions from each achievement. While preparing the questions, they were formed in line with the opinions of experts by using various test books at the 5th grade level. In order to determine the suitability of the questions for the learning outcomes, the opinions of 2 lecturers who are experts in their fields, a Science teacher with 10 years of experience to determine their suitability for the age level, and a Turkish teacher with 8 years of experience were consulted to determine the compatibility of the questions with grammar rules.

In line with the opinions received, necessary corrections were made in the Change of Matter Achievement Test and the test was administered to 50 6th grade students in a secondary school in Defne district of Hatay province, who had covered the relevant subject before. Based on student answers, 25 multiple-choice test questions from open-ended questions were formed by choosing one correct option and three incorrect options, again from student answers.

In order to test the suitability of the questions, they were shown again to the lecturers who are experts in their fields and necessary corrections were made. The "explanation" part was added to the bottom of each question and applied to 60 students studying in the 6th grade of a secondary school in Izmir. In line with the students' answers, three wrong explanations and one correct explanation were added to the questions, and the final version of the two-stage test was given after taking the opinions of experts in the field of science and grammar again.

In order to calculate the validity and reliability of the test, 5th grade students were expected to complete the activities in the Change of Matter unit. Thus, it is aimed to be more up-to-date and give more accurate results. The test consisting of 25 questions was applied to 218 students in 4 different secondary schools in the province of Hatay and its descriptive statistics are given in Table 2 to make reliability calculations.

Table 2. Descriptive statistics of the Change of Matter Achievement Test

Variable	x	Ss	Kurtosis	Swekness
CMAT	5,701	4,152	-,462	,657

When the descriptive statistics data of the test are examined in Table 2, it is seen that the data belonging to CMAT show a normal distribution since the kurtosis and skewness values are between -3 and +3 (Kalaycı, 2006). The substance discrimination indexes of the test are given in Table 3.

Table 3. Substance index of distinctiveness of test questions

Question number	Distinctiveness	Question number	Distinctiveness	Question number	Distinctiveness	Question number	Distinctiveness	Question number	Distinctiveness
1	0,61	6	0,81	11	0,69	16	0,28	21	0,26
2	0,70	7	0,19	12	0,26	17	0,67	22	0,15
3	0,65	8	0,50	13	0,70	18	0,41	23	0,22
4	0,67	9	0,61	14	0,13	19	0,63	24	0,30
5	0,57	10	0,61	15	0,54	20	0,48	25	0,30

When Table 3 is examined, questions with an substance discrimination index below 0.30 were excluded from the test. As a result, 18 questions, 2 of which are distinctive and 16 of which are very distinctive, were taken to the test. After discarding the non-discriminatory questions in the test, the average distinctiveness of the test was calculated as 0.57. When the distinctiveness of the test questions is evaluated in general, it can be said that the test is very discriminating. The substance difficulty indexes of the test questions are given in Table 4.

Table 4. Substance difficulty index of test questions

Question number	Difficulty of the substance	Question number	Difficulty of the substance	Question number	Difficulty of the substance	Question number	Difficulty of the substance	Question Number	Difficulty of the substance
1	0,42	6	0,57	11	0,36	16	0,16	21	0,15
2	0,48	7	0,09	12	0,17	17	0,35	22	0,15
3	0,42	8	0,27	13	0,39	18	0,22	23	0,17
4	0,35	9	0,45	14	0,08	19	0,43	24	0,15
5	0,36	10	0,44	15	0,29	20	0,30	25	0,15

As can be seen in Table 4, there are no easy questions in the test questions with an substance difficulty of more than 0.60. Since the difficulty of 7 questions in the test is between 0.60 and 0.40, 7 questions in the test are of medium difficulty. Since the difficulty of the 18 questions in the test is below 0.40, those questions are the hard questions in the test. 7 questions with low substance distinctiveness were calculated as very difficult questions and were excluded from the test. There are 18 questions left in the test, 7 of which are medium difficulty, 9 are difficult and 2 are very difficult. The average difficulty of the remaining questions in the test is 0.34. So it can be said that the test is a difficult test. The KR20 reliability coefficient was calculated using the formula given below.

$$KR_{20} = \frac{K}{K-1}\left[1 - \frac{\sum pq}{S_x^2}\right]$$

K = number of questions in the test
p = substance difficulty
q = 1-p
S_x^2 = variance of the test (Büyüköztürk, Çakmak, Akgün, Karadeniz, & Demirel, 2010).

The KR-20 internal consistency coefficient of CMAT, calculated according to the above formula, is 0.82. According to the data obtained, the final version of the test consisting of 18 questions is suitable for the 5th grade level of secondary school, it is a very distinctive (0.57), difficult (0.34) and reliable test. Finally, the researcher determined that the test was also valid by preparing an indicator table to check the content validity after the questions were removed. The highest score that can be obtained from CMAT is 18 and the lowest score is 0. Scoring of the test was done according to table 5.

Table 5. Scoring of CMAT

Situation	Score given to the substance
Response and Explanation is Correct	1
Response Correct, Explanation Wrong	0
Response Wrong, Explanation Correct	0
Response and Explanation is Wrong	0

When the scoring method of CMAT given in Table 5 is examined, it is seen that 1 point is given when the correct answer option is marked with the correct explanation to the questions.

Argumentative Attitude Scale (AAS)

The Argumentative Attitude Scale (AAS), prepared by Infante and Ranger (1982), is a 5-point Likert-type, 20-substance scale applied to determine individuals' interest or avoidance in scientific discussion. While 10 of the substances in the scale, which was adapted into Turkish by Kaya and Kılıç (2008), measure positive attitudes towards scientific discussion, the other 10 measure individuals' negative attitudes towards discussion. For each question in the scale, the highest 5 points from positive to negative points and the lowest 1 points can be obtained. In substances for negative attitudes, scoring is done in reverse. The scores that can be obtained from the scale range from 20 to 100.

While Yalçın-Çelik (2010) completed the validity-reliability studies of the scale for high schools, the validity-reliability studies for middle school were carried out by Öztürk (2013), and the Cronbach Alpha internal consistency reliability coefficient was calculated as 0.73 in the study for secondary school.

Problem Solving Inventory (PSI)

The Problem Solving Inventory (PSI), which aims to measure how individuals react to personal and daily life problems and how individuals behave, was developed by Heppner and Peterson (1982). The adaptation of the scale to Turkish culture was done by Şahin (1993) and Taylan, (1990), and this scale is generally used in studies conducted with university and high school level and adults (Korkut, 2002; Şahin, Şahin, & Heppner, 1993; Taylan, 1990; Tümkaya & İflazioğlu, 2000).) used. Kardaş, Anagün, and Yalçınoğlu (2014) adapted the PSI to the 5th grades of primary education and conducted validity and reliability studies of the scale.

The original version of the scale consists of 35 6-point Likert-type substances and 3 dimensions: "confidence in problem solving ability", "approach-avoidance" and "personal control". After being adapted to the primary education level, the scale became a 4-point Likert-type scale consisting of 20 substances. The lowest score that can be obtained from the scale is 20, and the highest score is 80. The negative substances of the scale, which includes both positive and negative substances, are scored inversely.

Taylan (1990) states that a low score in scoring indicates the development of problem-solving ability, and a high score indicates that effective solutions to problems cannot be found. The Cronbach Alpha internal consistency reliability coefficient of the PSI was calculated as 0.74 and the Sperman-Brown split half reliability coefficient as 0.80 (Kardaş, 2013; Kardaş, Anagün, & Yalçınoğlu, 2014).

Practice of Teaching Approaches Used in the Research

The study was carried out with 5th grade students studying in two separate branches in a secondary school in Defne district of Hatay province in the 2015-2016 academic year. The practice was carried out by the researcher in both branches. Practice; It was completed in a total of 6 weeks, of which 20 course hours (5 weeks) were applied to the methods and 4 course hours were data collection. One of the branches where the practice will be made was randomly determined as the Argumentation Group (AG) and the other as the Existing Program Activities Group (EPAG) and the research process was started. Before the start of the study activities and at the end of the study, both groups were administered the Change of Matter Achievement Test (CMAT), Argumentative Attitude Scale (AAS) and Problem Solving Inventory (PSI) as pre-test and post-test.

Implementation of Argumentation Activities

Before the research, the necessary information about the practice process of the model was given to AG by the researcher and the relevant measurement tools were applied to determine the students' initial levels in terms of the variables to be evaluated in the study.

The activities to be applied to the argumentation group were prepared by the researcher by examining Timms questions, based on the achievements in the 2013 Science Curriculum. After taking the opinion of a faculty member who is an expert in the field of activities, the opinions of an experienced Turkish Teacher for language suitability and an experienced Science Teacher for suitability for the 5th grade level were taken. In order for them to internalize the argumentation model, the "Constructing an Argument" activity was carried out as a large group discussion with an example from daily life, according to the scheme Toulmin suggested (2003) in the first lesson. In order for the discussion groups to be able to conduct the discussion scientifically and not to turn it into personal discussions, the precautions to be taken were explained to the students. In the discussion process, the researcher prevented the criticism from being directed to individuals by making appropriate guidance to the students when deemed necessary and directed them to care about each other's ideas.

The students were informed that the lessons will be conducted with 11 activities prepared for the achievements of the third unit (Change of Matter). For the implementation of the activities, the class of 35 people was divided into 6 groups, 5 groups of 6 people and 1 group of 5 people, in a heterogeneous way in terms of success, considering the pre-test scores of CMAT. Tasks were distributed in groups such that one student was the speaker, one was the writer, and the other students were the idea counselors. The activity directive prepared by the researcher was distributed to the groups at the beginning of the practices. The students in the group were asked to write their predictions about the questions in the first part of the instruction and their final answers to the related question in a small group discussion. After all groups completed this section, group spokespersons shared their ideas. Then, the second part of the activity, the "observation" part, was passed and the materials required for the activity were given to each group by the researcher. The writer recorded his observations in the activity guide, taking into account the ideas of the group members. In the last part of the practice, "explain", the students compared their observations with their predictions in their own groups. They tried to identify the supporting and refuting aspects of their ideas. At the end of the lessons, a large group discussion was held, allowing the students to defend their own ideas and to identify the shortcomings of the other groups. At the end of the discussion, the students were asked how their ideas had changed. During the stages of the practice, the researcher wandered between the groups and became a guide in cases where they were lacking or having difficulties. All activities were implemented through the same stages. In the sixth week, which is the last week of the study, CMAT, AAS and PSI were applied as post-tests, and the study was terminated.

Implementation of Existing Program Activities

In the branch chosen as the existing program activities group (EPAG), the courses were carried out with the activities in the current program. The activities were created by considering the regulations of the Ministry of National Education in 2013, and the Science textbook was also used. Students were encouraged to participate in the lesson by using active learning methods such as large group (class) discussion, demonstration, and question-answer techniques. In the experiments conducted on the subject in EPAG students, the subject was covered by using the notation method. At the beginning of the experiment, the students were asked about their predictions about the results of the experiment, and at the end of the experiment, class discussions were held. Class discussions were guided by the researcher's open-ended questions (How?, Why do you think so?...). When the subject did not include an experiment activity, students' prior knowledge was measured with open-ended questions, and examples from daily life were included to reinforce the subject. In EPAG and AG, the same topics were covered in the same week, at the same time. In the sixth week, which is the last week of the study, CMAT, AAS and PSI were applied as post-tests, and the study was terminated.

Analysis of Data

In the research, descriptive and inferential statistical methods were used by using the statistical package program for the analysis of the data. With these statistical methods, the normality status of the experimental and control groups was checked for pre-test-post-test evaluations, and independent groups t-test, dependent group t-test and ANCOVA were applied for data showing normal distribution.

FINDINGS AND DISCUSSION

In order to decide which test will be used in the evaluation of the data obtained from the pre-tests applied to the groups in the research, the normality of the tests should be examined. Because of this situation, Kolmogorov-Smirnov Test, which is one of the normality tests that will be used in case the study group has more than 30 people, was used to see whether the tests show a normal distribution (Kalaycı, 2006). The descriptive statistics and normality test results applied to the pre-tests of the data collection tools are given in Table 6.

Table 6. CMAT, AAS and PSI pretest descriptive statistics and normality test results

Group	Test	N	x̄	S²	S	Kurtosis	Swekness	Kolmogorov- Smirnov	p
	CMAT		4,800	4,812	2,194	-,556	-,599	,194	,002
	AAS		62,743	167,667	12,949	-,079	-,313	,082	,200
AG	PSI	35	33,371	82,887	9,104	,885	1,186	,170	,012
	CMAT		3,121	4,172	2,043	-,654	,505	,163	,026
	AAS		56,485	168,320	12,974	-,324	,007	,074	,200
EPAG	PSI	33	39,455	67,318	8,205	-,798	,367	,178	,009

When the AG Kolmogorov- Smirnov test results in Table 6 are examined, it is seen that the CMAT pretest and PSI pretest data do not show normal distribution (p<.05), while the AAS pretest shows normal distribution (p>.05). However, since the kurtosis and skewness values of these tests vary between -3 and +3, it was decided that they were suitable for normal distribution (Kalaycı, 2006). According to EPAG Kolmogorov- Smirnov Test results, AAS preliminary results showed normal distribution (p>.05), while CMAT preliminary and anterior PSI results did not show normal distribution (p<.05). However, since the kurtosis and skewness values of these tests were between -3 and +3, it was decided that they were suitable for normal distribution (Kalaycı, 2006). From this point of view, it was decided to use parametric tests in the analysis, assuming that the pre-test data of the groups showed a normal distribution.

The descriptive statistics and normality test results applied to the posttests of the data collection tools are given in Table 7.

Table 7. CMAT, AAS and PSI post-test descriptive statistics and normality test results

Group	Test	N	x̄	S²	S	Kurtosis	Swekness	Kolmogorov- Smirnov- Z	p
	CMAT		7,686	17,634	4,199	-,092	,042	,092	,200
	AAS		64,029	255,734	15,992	-1,020	-,098	,098	,200
AG	PSI	35	33,400	76,953	8,772	,196	,852	,175	,008
	CMAT		5,758	17,064	4,131	-1,464	,311	,202	,001
	AAS		55,121	225,047	15,002	,016	,598	,130	,170
EPAG	PSI	33	40,061	97,559	9,877	-,470	,099	,124	,200

According to the AG post-test Kolmogorov-Smirnov test results in Table 7, while CMAT and AAS showed a final normal distribution (p>.05), PSI final data did not show a normal distribution according to Kolmogorov- Smirnov test results (p<.05), and kurtosis and skewness values were checked. Since these values were between -3 and +3, it was concluded that they showed a normal distribution. According to the EPAG posttest Kolmogorov- Smirnov test results, AAS posttest and PSI posttests show normal distribution (p>.05), while CMAT posttest data do not show normal distribution (p<.05). However, since the kurtosis and skewness values of these tests were between -3 and +3, it was decided that they were suitable for normal distribution (Kalaycı, 2006). As a result, it was decided to use parametric tests in the analysis, assuming that the post-test data of the groups showed a normal distribution.

Independent t-test was applied to determine whether there was a difference between the mean scores of the groups' CMAT pre-test scores and the results are given in Table 8.

Table 8 Independent t-test results of the CMATpretest of the groups

Group	N	x	S	df	t	p
AG	35	4,800	2,194	66	3,261	,002*
EPAG	33	3,121	2,043			

*p< ,05

As can be seen in Table 8, a statistically significant difference in favor of AG was found between the CMAT pre-test mean scores of the groups (t = 3.261; p< .05). In this respect, it can be said that the groups' prior knowledge about the relevant unit before the practicewas not equivalent. Many of the researchers (Altun, 2010; Erdoğan, 2010; Gültepe, 2011; Hacıoğlu, 2011; Özkara, 2011; Taşpınar, 2011; Ceylan, 2012; Küçük, 2012; Okumuş, 2012; Uluay, 2012; Aydın, 2013; Öztürk, 2013) ; Arlı, 2014) worked with groups that were equivalent to each other in terms of pre-test success. However, the fact that Uluçınar-Sağır (2008) and Aslan (2010)'s study groups showed a significant difference in the pre-test success in favor of the experimental group supports the research result. It is thought that the fact that different teachers attended the classes in the primary school of the classes that make up the groups may have created a difference in success between the groups.

Since there was a significant difference between the CMAT pretests of the groups, analysis of covariance (ANCOVA) was used to control the effect of CMAT pretest scores on CMAT posttest scores in the analysis of the mean CMAT posttest scores. Descriptive statistics of the CMAT post-test are given in table 9, and ANCOVA test results are given in table 10.

Table 9. Descriptive statistics of the CMAT posttest of the groups

Group	N	Unreformed x	Ss	Reformed x
AG	35	7,685	4,199	6,491
EPAG	33	5,757	4,131	7,025

Table 10. ANCOVA test results of the CMAT posttest of the groups

Source of Variance	Sum of Squares	Df	Avarage of Squares	f	p	η^2	Power
Pretest	639,130	1	639,130	82,025	,000	,558	1,000
Group	4,173	1	4,173	,536	,467	,008	0,111
Mistake	506,473	65	7,792				
Total	4307,000	67					

When Table 10 was examined, when the mean CMAT pre-test scores were taken as the common variable, no statistically significant difference was found between the mean CMAT post-test scores of the groups (p> ,05). According to Cohen (1988), if the Eta Square value is between .01 and .02, the small effect value; .06 is the medium effect value; If it is between .14 and .20, it is interpreted as a large effect value. Looking at the Eta Square value in Table 10, it can be said that the research conducted has a small effect on academic achievement (η^2= ,008). In other words, the applied methods did not cause a statistically significant difference on the achievements of the groups. In this respect, it can be argued that the constructivist approach and argumentation model on which current curriculum activities are based increase student achievement in groups at approximately the same level.

Considering the studies in the literature, it was determined that there was a significant difference between student achievements in favor of the group to which the argumentation model was applied and that the argumentation model increased success (Altun, 2010; Ceylan, 2012; Okumuş, 2012; Okumus & Unal, 2012; Özer, 2009; Taşpınar, 2011; Tekeli , 2009; Uluay, 2012; Uluçınar- Sağır, 2008; Yalçın- Çelik, 2010; Yalçınkaya, 2018; Yeşiloğlu, 2007). The findings of the study do not agree with this result in the literature. However, when the methods applied to the control groups compared with the argumentation model of the mentioned studies are examined (except for Kara, Yılmaz, & Kıngır, 2020; Okumuş, 2012; Taşpınar, 2011) have been found to be traditional methods in most of them. In other words, it can be said that the implementation of the constructivist approach activities on which the Science Curriculum is based in the control group of the study may have caused the success of the control group to increase in the ratio of the success of the experimental group and that there was no significant difference between them.

In order to determine whether there is a statistically significant difference between the mean scores of the groups in the AAS pre-tests, the groups t-test, independent of the parametric tests, was applied. The independent t-test results of the data are given in Table 11.

Table 11. T-test results of the AAS pretest of the groups

Group	N	$\bar{x}$	S	df	t	p
AG	35	62,743	12,949	66	1,990	,051
EPAG	33	56,485	12,974			

According to Table 11, since there is no statistically significant difference between the groups' AAS pre-test scores (p> ,05), it can be said that the argumentative attitudes of AG and CMAT are similar to each other before the practice. Looking at the literature, it is seen that similar studies (Öztürk, 2013) support this finding.

In order to understand whether there is a statistically significant difference between the averages of the groups' AAS post-test scores, the independent t-test was applied and the analysis results are given in Table 12.

Table 12. T-test results of the AAS posttest of the groups

Group	N	$\bar{x}$	S	df	t	p	η²
AG	35	64,029	15,992	66	2,365	,021*	,078
EPAG	33	55,121	15,002				

N> 30, *p< ,05

When Table 12 is examined, a statistically significant difference in favor of AG was found between the mean AAS post-test scores of AG and EPAG (t = 2, 365; p= .021; p< .05). With the data obtained, it can be said that the argumentation model affects the argumentative attitudes of the students in the groups more positively than the methods predicted by the current program. In addition, the eta square (η^2) value of .078 indicates that the argumentation model has a moderate effect on attitude (Cohen, 1988).

According to Deveci (2009) and Yalçın- Çelik (2010), group work has a more positive effect on students' argumentative attitudes than individual or class discussions. The reason for this situation can be shown as the inclusion of both small group discussion and class discussions in each activity in the practice process of AR. Whereas, in EPAG only class discussions were included and it was applied less frequently and generally at the end of the lesson compared to AG. When the related studies (Demirci, 2008; Erdoğan, 2010; Öztürk, 2013; Tekeli, 2009; Uluçınar- Sağır, 2008; Yalçın- Çelik, 2010) are examined, it is seen that they support the findings of this study. development is emphasized.

In order to analyze whether there is a statistically significant difference between the mean scores of the groups in the PSI pre-tests, the t-test independent of the parametric tests was applied and the results are given in Table 13.

Table 13. T-test results of the PSI pre-test of the groups

Group	N	$\bar{x}$	S	df	t	p
AG	35	33,371	9,104	66	-2,888	,005*
EPAG	33	39,455	8,205			

N> 30; *p< ,05

Looking at Table 13, a statistically significant difference in favor of AG was found between the mean PSI pre-test scores of the groups (t = -2, 888; p< ,05). In other words, the problem solving self-confidence of the groups is not equal before the practice and it can be said that AG students' problem-solving perceptions are stronger than EPAG students.

Analysis of covariance (ANCOVA) was applied to control the effect of PSI pretest scores on PSI posttest scores of the students in the groups, and the test results are given in Table 14 and Table 15.

Table 14 Descriptive Statistics of the PSI scores of the groups

Group	N	Unreformed x	Ss	Reformed x
AG	35	33,400	8,772	35,480
EPAG	35	40,061	9,877	37,854

Table 15. ANCOVA test results of the PSI scores of the groups

Source of variance	Sum of Squares	Df	Avarage of Squares	F	p	η²	Power
Pretest	2469,103	1	2469,103	49,092	,000	,430	1,000
Group	84,984	1	84,984	1,690	,198	,025	0,249
Mistake	3269,176	65	50,295				
Total	6491,809	67					

According to the ANCOVA test results in Table 15, no statistically significant difference was found between the mean PSI post-test scores of the groups (p> ,05). Looking at the Eta Square value in Table 15; Since η^2= ,025, it can be said to have a small effect value (Cohen, 1988). In other words, it is seen that the constructivist approach and the argumentation model on which the current curriculum activities are based do not make a statistically significant difference on the problem solving perceptions of the groups.

The study of Kardaş (2013), which is included in the relevant literature, supports this finding obtained from the research. In his study with undergraduate students, Rebello (2012) found that students improved their problem-solving repertoire with argumentation activities. Although Korkut (2002) found that problem solving perceptions develop more as the age decreases, he attributed this to the fact that they may not have given realistic answers due to their age. The reason why students do not trust their problem solving skills enough can be shown as being young and not having a little experience and experience (D'Zurilla, Maydeu, & Kant, 1998). In addition, the short duration of the study may have been insufficient to develop problem-solving perceptions, which are high-level thinking skills (MEB, 2018) (Küçük, 2012). Long-term studies can further develop higher-order thinking skills (Aslan, 2010; Gültepe, 2011). Apart from these, there are studies showing that many factors such as gender, age, school type, parents' job, and the people they get help from in solving their problems make a difference in problem solving (Korkut, 2002). It can be concluded that the difference between the problem solving perceptions of AR and EPAG students may be due to the fact that they are equal groups in terms of factors such as age and school type, and that the current program activities are based on the constructivist approach (MEB, 2013).

CONCLUSION AND RECOMMENDATIONS

In the research, it was aimed to determine the effects of the activities envisaged by the current program and the implementation of argumentation activities in the teaching of the Change of Matter unit of the 5th grade Science course on the academic success, argumentative attitudes and problem solving skills of the students.

At the end of the practice, no significant difference was found between the groups in terms of academic achievement (Table 10). When the relevant literature is examined, there are many studies showing that the argumentation model increases academic success (Altun, 2010; Arlı, 2014; Ceylan, 2010; Demirbağ, 2011; Demirbağ & Günel, 2014; Deveci, 2009; Domaç, 2011; Erdoğan, 2010; Kabataş. - Memiş, 2011; Özer, 2009; Özkara, 2011; Uluay, 2012; Uluçınar- Sağır; 2008; Uluçınar- Sağır and Kılıç, 2013; Yalçınkaya, 2018; Yeşiloğlu, 2007). However, control group activities in related studies are based on the traditional method. In this study, the unit in EPAG, which is the control group, was processed with activities prepared in accordance with the constructivist approach envisaged by the current program. According to MEB (2013) and MEB (2018), the argumentation model is also a model suitable for the constructivist approach. In other words, this result can be interpreted as the inability to detect a statistically significant difference between the averages of AG and EPAG CMAT post-test scores, since the models and methods applied in AG and EPAG are suitable for the same approach. According to Taşpınar (2011) scientific discussion activities increase content knowledge more than the constructivist approach. In addition, it is a condition of being scientifically literate that individuals can adapt their knowledge to new situations they encounter and use knowledge (MEB, 2018). The model applied in AG in this study was insufficient to guide students on how to use the content information they acquired, therefore, there was no significant difference between the AG and EPAG final CMAT averages, which may be the reason for this result. In addition, in the absence of a significant difference between student achievements; It is thought that some students from AG and EPAG attended the Science course, which is one of the courses given in schools, but the participation of the students in the course was not taken into account while the study was being evaluated. When the relevant literature is examined, it has been emphasized that the length of the implementation period of scientific discussion activities is important in terms of affecting success (Uluçınar- Sağır, 2008; Uluçınar and Kılıç, 2013). Considering this dimension, it is thought that the implementation period of the study may have affected the success.

At the end of the practice, a significant difference was found between the groups in favor of the experimental group in terms of perceptions of discussion skills (Table 12). Studies in the literature in which the argumentation model positively affects perceptions of discussion skills support this finding (Demirci, 2008; Okumuş, 2012; Prudchenko, 2014; Shoulders, 2012; Tekeli, 2009; Uluçınar- Sağır, 2008; Uluçınar- Sağır & Kılıç, 2013).). It is thought that making students have discussions in each activity in AG and carrying out these discussions as a group is effective in the emergence of this finding. Günel and Demirbağ(2012) found that there is a high correlation between teachers' questioning strategies and the formation of classroom discussions. Based on this, it can be said that the support of the discussions with open-ended questions by the researcher is effective in the continuation of the discussions and thus in the adoption of the discussion by the students. In addition, it is thought that including examples from daily life in the activities used during the practice may have improved AR's argumentative attitudes. On the other hand, according to Cho (2001), the use of graphics along with the text in the discussions ensures that more and more quality arguments are produced. There are also studies reporting that modal descriptions (figures, pictures, graphics, tables) have a positive effect on discussion skills (Demirbağ, 2011; Demirbağ & Günel, 2014). Graphics, tables and other visual elements were also used in the activities implemented in AG, thus encouraging active participation of the students in the discussion. This may also have had an effect on the change in students' attitudes.

At the end of the practice, no statistically significant difference was found between the groups in terms of perceptions of problem solving skills (Table 15). Although there are studies in the related literature (Cho, 2001; Rebello, 2012) showing that practices organized with argumentation activities improve problem-solving infrastructures, according to Cho (2001), the type of problem affects student argument significantly. In addition, there are studies in the literature that emphasize the importance of the effect of personal experience and interest in the subject, which were not evaluated in this study, on problem-solving skills (Karışan, 2011; Kutluca, Çetin, & Doğan, 2014). Apart from this, although Sampson II (2007) stated in his study that students who work in groups are better at solving problems; They found that student groups could not produce better products than students working alone, and they interpreted this as the inability of individuals to always adopt and internalize group outputs. The study of Yıldan-Aslan (2018) on the effect of the argumentation model, in which he could not detect a difference in problem solving skills between the experimental and control groups, also supports this study. In addition, it is thought that the constructivist approach applied in the control group may cause no difference between the problem solving perceptions of the groups.

Based on these results, longer-term studies should be conducted to investigate the effect of argumentation activities on success. In order to develop problem solving perceptions, the discussion should include ill-structured problems that increase the frequency of identifying opposing views and the quality of individual problem-solving arguments, and it can be said that choosing a topic that is intertwined with daily life in the discussion may be more beneficial.

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Statements of publication ethics

We hereby declare that the study has no unethical issues and that research and publication ethics have been observed carefully..

Researchers' contribution rate

While the application part of the research was carried out by the first author, all other stages were carried out with the cooperation of both authors.

Ethics Committee Approval Information

This study was carried out by obtaining the necessary permissions from the Hatay Provincial Directorate of National Education for the first author's master's thesis applications in the 2015-2016 academic year.

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