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The Effect of Value Driven Activities on Students' Value Perceptions, Problem Solving Skills and Attitudes toward Mathematics[1]

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Abstract

The purpose of this study was to investigate the effect of value driven activities on mathematics achievement, value perceptions, problem-solving skills, attitudes towards mathematics, and retention in the 6th grade Mathematics Practices Lesson (MPL). The study was informed by principles of a values education and employed a quasi-experimental design that included a pre-test/post-test control group. The study group consisted of the 6th graders in a public school registered to an elective MLP. Data collection tools were The Value Perceptions Scale (VPS) and Academic Achievement Test (AAT), Attitude towards Mathematics Scale (AtMS), and Problem Solving Inventory (PSI). According to the results, there was a significant difference between the experimental group's VPS pre-test, post-test, and retention total scores in favor of the post-test scores. In addition, there was a statistically significant difference between the post-test total score of the experimental group and the post-test total score of the control group in favor of the experimental group. This indicates the MPL incorporated values instructional activities that significantly affected the students' value perceptions in the experimental group. There was no significant difference between the post-test PSI total scores of the students in both groups. No statistically significant difference was observed between the post-test total score of the control group and the post-test total scores related to AtMS. There was no significant difference between the AAT post-test total scores of the students in the experimental group and the post-test total scores of the students in the control group who did not receive the experimental activities.

Keywords: Mathematics practices lesson; problem solving; values education; value perceptions

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Introduction

Individual and social peace are the principal functions of values and values education. The positive development of the individual and society to ensure individual and social peace is related to values and values education (Aydın & Akyol Gürler, 2014). As Ulusoy and Dilmaç (2016) emphasized, when teaching students values, it is important for teachers to present a realistic, yet not pessimistic, picture of the world and people. The task, then, is for teachers to be supportive of and to model the behaviors and attitudes of individuals, be they a parent, a teacher, or a citizen, who exemplifies the practices of values education. School environments and teacher education are important factors in achieving individual and social peace through education, and teachers should be trained to be role models in love, honesty, human values, right behavior, peace, and a life without violence (Ishii, 2010;

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Tillman, 2000). Therefore, while the need for values education is felt in terms of individual and social peace, a primary responsibility of educators is to effectively employ the principles and practices of values education in schools (Lopes, Oliveira, Reed & Gable, 2013).

Implementation of the curricula requires a non-coincidental and planned education to achieve effective values education both through formal and hidden curricula (Aydın & Akyol Gürler, 2014; Yazıcı, 2006). This involves different lesson designs to meet the developmental needs of children in both primary and secondary schools. However, there is no certain standard regarding values education in the curriculum. While values education has been handled in a detailed and planned manner for years in the 'Religious Culture and Moral Knowledge' (RCaMK) and 'Social Studies' curriculum until 2017, it has been observed that values education is not reflected thoroughly in other lessons (Köylü, 2016).

A general view of teaching mathematics is that there must be a focus on its cognitive aspect, however the affective aspect of mathematics, especially the dimension of teaching values must also be given importance. Nik Pa and Tapsir (2013) posit that the fact that most people see mathematics as value-free is due to the notion that they have various perceptions about what is found. However, studies on the affective domain of mathematics education point to influential variables such as attitude, motivation, anxiety, beliefs and values as being strongly dependent on mathematics teaching and learning quality. Only in this way will students have the opportunity to understand the precision, beauty, aesthetics, consistency, abstraction, and progressive aspects of mathematics (Dede, 2007). In Turkey, the elementary school mathematics curriculum implemented in 2005, 2009, 2013, 2017, and 2018 emphasized that it is necessary to make students acquire affective characteristics, such as "enjoys dealing with mathematics", "discusses issues related to mathematics", "gains awareness of the importance of mathematics in real life", and "helps people who want to learn mathematics" (Doruk, 2011). However, the title "Values Education in the Curriculum" was not included in the middle school mathematics curriculum developed in 2005, 2009 and 2013. In the mathematics lesson curriculum implemented in the 2017-2018 academic year, the objectives of different values included 'justice, sharing, scientificity, flexibility, aesthetics, equality, tolerance, freedom, patience, respect, responsibility, and savings' (MONE, 2017). In addition, the mathematics curriculum implemented in 2018 included the values of 'justice, friendship, honesty, self-control, patience, respect, love, responsibility, patriotism, and benevolence', all of which were presented as 'root values' (MONE, 2018).

The affective objectives of the Mathematics Practices Lesson (MPL) are for students to contribute to the mathematics lesson, to establish the relationship between the mathematics lesson and other disciplines, to become endeared to mathematics, and thus to raise individuals who will show the patience and devotion required for mathematics (MONE, 2012). Thus, the fact that the activities of MPL can be associated with values education constitutes a critical need for conducting this research.

The level of mathematics achievement continues to be of great importance in the academic success that students will achieve throughout their education life. In this respect, it is clear why MPL was one of the most preferred elective lessons in 2015 (Karagözoğlu, 2015). Research on values education has included studies on the effectiveness of the values curriculum in different lessons (social studies, life studies, science, etc.) and teachers' views on values education (Tulunay Ateş, 2017). Research on the role of mathematical values and mathematics education often refers to the studies conducted by Alan Bishop in Australia. Accordingly, a framework based on Bishop's work has been established around six values: rationalism, objectivism, control, progress, openness, and mystery (Atweh & Seah, 2008). Bishop and Seah (2003) state that although values are the heart of all lessons, they are rarely explained in the field of mathematics education. Therefore, there is a need in the field for studies that take into account a range of variables, including the effects of mathematics-related values education activities, the value perceptions of these activities, and other variables (academic achievement, problem-solving skills, attitude towards mathematics, etc.). International, studies have been conducted to examine the application of mathematical values curricula across different countries, and these have also analyzed the values of mathematics teachers (Bills and Husbands, 2005; Bishop, FitzSimon and Seah, 1999; Bishop and Seah, 2003; Nik Pa & Tapsir, 2013).

While research on the relationship between mathematics education and values has been limited, past studies have examined explanations on mathematical values in mathematics teaching (Dede, 2007; Dede, 2012; Durmuş, 2004; Durmuş, 2011), the presence of values in the mathematics curriculum

(Kirez, 2018; Tan-Şişman & Kirez, 2017), exam questions (Yaprakgül, 2019), the values of expressed by mathematics teachers (Demir, Somuncu-Demir, and Durmuş, 2012; Durmuş, et al., 2008; Kirez, 2018), and the placement of values in mathematical textbooks (Özenç, 2019). Additionally, there are studies that address the ways in which opinions about values in the mathematics curriculum are expressed (Deniz, 2018), as well as how values are represented within both middle school mathematics textbooks and mathematics curricula (Yıldız, 2019). Other studies have the relationship between activities that associate mathematics education with values (Aydemir Özbay, 2019; Çelebi, 2020; Doruk, 2012; İpekçi, 2018; Özsoy, et al. 2018; Turhan Türkkan, 2017). As discussed in this study, no experimental study was found in which the values (scientificness, academic self-confidence and responsibility) developed for mathematics activities were handled with different variables (academic achievement, problem solving skills, attitude towards mathematics) in this study. The MPL has been developed to support the compulsory mathematics lesson for students to gain more advanced mathematical problem solving experiences (MoNE, 2012). In this study, in which mathematics education is associated with values education, the reasons for choosing the MPL 'course in particular are that the course has affective attainments, includes more application activities than the mathematics course, and is problem-solving oriented.

According to the results of the research conducted by Tulunay Ateş (2017), the effect of values education in high school and middle (secondary) school has been the acquisition of positive characteristics by students, while the level of acquisition of desirable characteristics has been less significant for primary school students. For this reason, after the results of the research that resulted in primary school students staying in the background on values education, it also focuses on whether this effect continues in middle school students. Therefore, this research contributes new knowledge by examining the effects of activities in which mathematics and values are associated with students' academic achievement, value perceptions, problem-solving skills, and attitudes towards mathematics. The primary goal of the study is to examine the effects of MPL activities that are incorporated by values education in middle school (6th grade) MPL on students' academic achievement, value perceptions, problem-solving skills, attitudes towards mathematics, and retention. In line with this general goal, answers to the following questions were sought:

1) Is there a significant difference between the pretest, posttest and retention total scores of the Value Perceptions Scale (VPS) of the students in the experimental and control groups?

2) Is there a significant difference between the pretest, posttest and retention total scores of the Problem Solving Inventory (PSI) of the students in the experimental and control groups?

3) Is there a significant difference between the pretest, posttest and retention total scores of the Attitude Towards Mathematics Scale (ATMS) of the students in the experimental and control groups?

4) Is there a significant difference between the Academic Achievement Test (AAT) pre-test, post-test and retention total scores of the students in the experimental and control groups?

Method

Research Model

This research was designed as a pretest-posttest unpaired control group quasi-experimental study. The independent variables of the study were 'MPL activities incorporated by values education' applied in the experimental group and 'regular/traditional MPL activities' applied in the control group, as was stated in the current curriculum.

Study Group

The study group, selected through convenience sampling, consisted of sixth graders of the public school in Çanakkale province, Türkiye selected. Fifty-one 6th graders were separated into two groups. Value Perceptions Scale (VPS), Problem Solving Inventory (PSI), Attitude towards Mathematics Scale (AtMS), Academic Achievement Test (AAT) were implemented in the experimental and control groups, before and after the instructional processes, and the retention levels of all of these were also measured. No significant difference was observed for the pre-test VPS, PSI, AtMS, and AAT between the two groups. The number of students included for analyses was 15 (10 girls and 5 boys) for the

VPS in the experimental group; 20 for PSI (12 girls and 8 boys), 20 for AtMS (12 girls and 8 boys), 20 for AAT (12 girls and 8 boys); in the control group, it was determined as 17 (7 girls and 10 boys) for VPS, 21 (9 girls and 12 boys) for PSI, 21 (9 girls and 12 boys) for AtMS and 21 (9 girls and 12 boys) for AAT.

Data Collection Tools

The main data collection tools were VPS (author, 2019), AAT (author, 2019), PSI (Kardaş, et al., 2014) and AtMS (Nazlıçiçek & Erktin, 2002). VPS and AAT were developed by the researchers. After obtaining official grants to administer PSI and AtMS, the scales were subjected to validity and reliability analysis by performing pilot applications with 255 sixth graders. Exploratory and confirmatory factor analyses were conducted to determine the construct validity of VPS, PSI, and AtMS. All other instruments were also administered to the students. A 'Value Assessment Form' was developed primarily by the researcher to develop VPS. The final values (responsibility, scientificity and academic self-confidence) were decided by taking into account the expert opinions of faculty members and mathematics teachers related to the Value Assessment Form (VAF), the values present within the MPL curriculum, and research findings found in relevant literature concerning mathematics values education. Following the statistical analyses, a VPS consisting of three factors and 16 items in five likert type was developed. The dimensions that emerged as a result of exploratory and confirmatory factor analyses were named as scientific, academic self-confidence, and responsibility (Authors, 2019). Of the remaining 16 items in the scale, eigth were collected in the first factor, four in the second and four in the third factor. The factor loads of these 16 items are between 0.72 and 0.86 and explain 68% of the total variance. The Cronbach α reliability coefficient of the scale was calculated as .90.

The researchers developed an AAT test originally containing 30 items at the cognitive domain comprised of three remembering, eight understanding, 16 applying, and three analyzing levels. This pilot multiple-choice test was first applied to 186 seventh-graders. Four multiple choiced twenty-one questions were selected out of 30 questions, taking into account the duration of one lesson hour (40 minutes). The average item difficulty of the test was 0.76, and the reliability (KR-20) coefficient was found as 0.89.

Implementation Process

The researcher in the experimental group and another math teacher in the control group took part in teaching to avoid the researcher influence. While the teacher in the control group conducted the lessons based on the current MPL curriculum, the students in the experimental group were subjected to the instruction based on affective attainments related to mathematics values in addition to the current MPL attainments. Additional goals for student engagement with the activities were to develop skills in establishing linkages between mathematics and daily life, and to provide students with correct values about mathematics that included attitudes of patience and effort required in problem-solving.

While developing the activities in the lesson plans applied to the experimental group, some teaching strategies (expository, discovery and inquire based) and instructional techniques (brainstorming, question-answer, case-study, discussion, educational game, pair-group work and problem solving). In the experimental group, evaluation procedures were also made through alternative assessment techniques such as demonstrations, anecdotes, discussions, projects, and oral presentations. The control group received current constructivist curriculum implementation during this process.

The class president elections, board, and smartboard attendants were selected in the first week for the 'responsibility' value to be considered in all subsequent weeks within the experimental group. Then, the responsibilities (maintaining classroom order, class notebook control, organizing the materials on the board before the lesson-collecting after the lesson, keeping the materials in the bag until the lesson, opening-closing the smart board, etc.) were announced to the class. While developing and implementing all activities, approaches such as value infusion, value disclosure, value analysis, discussion, certain (national) days and weeks, current events, stories, and educational games were taken into consideration. The implementation of the MPL experimental process, with two hours per week, took seven weeks. Pre-tests were conducted one week before implementations and the post-tests were conducted one week after the end of the applications. Six weeks after the post-tests, all retention tests were all re-administered.

Data Analysis

The kurtosis-skewness coefficients, central tendency measures, histogram graphs, normal Q-Q graphs, Kolmogorov-Smirnov and Shapiro-Wilk test normality analyses were taken into consideration to determine whether the VPS, PSI, AtMS, and AAT pre-test, post-test, and retention data were normally distributed. First, the normality of the scores was tested, then ANOVA was used for repeated measurements from parametric tests in groups with normal distribution, t-test for independent samples, with the Mann Whitney U test and the Friedman Test from nonparametric tests were administered for groups that did not normally distributed.

Findings

Findings Related to Value Perceptions

The results of the Friedman test are presented in Table 1. Table 1 shows that there is a significant difference in favor of the post-test between the total scores of VPS pre-test, post-test, and retention of the students in the experimental group, in which MPL activities incorporated with middle school 6th grade values education were applied (p=.034, p<.05).

Table 1
VPS Experimental Group Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	p		z	p
					Post/Pre	-3.017	.003**
Experimental	15	6.75	2	.034*	**Retention/Pre**	-1.024	.306
					Retention/Post	-1.100	.271

* p< .05 ; **p < .0167

According to the Wilcoxon test, there is a significant difference between the pre-test and the post-test in favor of the post-test (z=3.017, p<.05). In addition, the absence of a significant difference between the VPS post-test and retention total scores (p>.0167) indicates that there is retention.

The Friedman test results showing whether there is a significant difference between the VPS 'academic self-confidence' sub-dimension pre-test, post-test and retention total scores of the experimental group are presented in Table 2.

Table 2
VPS Experimental Group Academic Self-Confidence Pre-Test, Post-Test and Retention Total Scores

Group	N	FriedmanX^2	df	p		z	p
					Post /Pre	-2.731	.006**
Experimental	15	9.45	2	.009*	**Retention/Pre**	-1.689	.91
					Retention/Post	-1.606	.108

* p<.05 **p<.0167

In Table 2, there is a significant difference in favor of the post-test between the total scores of the VPS pre-test, post-test, and retention academic self-confidence sub-dimension scores of the students in the experimental group (p=.009, p<.05). Wilcoxon test indicates that there is a significant difference between the scores of the VPS pre-test and post-test academic self-confidence sub-dimension scores in favor of the post-test (z= -2.731, p<.05). In addition, the absence of a significant difference (p>.0167) between the post-test and retention academic self-confidence sub-scale total scores indicates that there is retention.

Friedman test results reveal that there is a significant difference between the pre-test, post-test, and retention total scores of the experimental group VPS 'scientificity' sub-dimension (Table 3).

Table 3

VPS Experimental Group Scientificity Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	p	z
Experimental	15	0.808	2	.67*	No difference

p>.05

Table 3 shows no significant difference between the scores of the students in the experimental group, VPS pre-test, post-test, and retention 'scientificity' sub-dimension scores (p=.668).

Friedman test results are presented in Table 4, to reveal whether there is a significant difference between the pre-test, post-test, and retention total scores of the experimental group VPS 'responsibility' sub-dimension.

Table 4

VPS Experimental Group 'Responsibility' Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	p	z
Experimental	15	3.3	2	0.192*	No difference

p>.05

According to Table 4, there is no significant difference between the VPS pre-test, post-test, and retention responsibility sub-dimension scores of the students in the experimental group (p=.192).

The Friedman test results are presented in Table 5 to reveal whether there is a significant difference between the control group VPS pre-test, post-test and retention total scores.

Table 5

VPS Control Group Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	p	z
Control	17	2.94	2	.23*	No difference

*p>.05

Table 5 shows no significant difference between the pre-test, post-test and retention total scores of the students in the control group (p=.23).

ANOVA test results are presented in Table 6 to reveal whether there is a significant difference between the pre-test, post-test and retention total scores of the control group VPS academic self-confidence sub-dimension.

Table 6

VPS Control Group Academic Self-Confidence Pre-Test, Post-Test and Retention Total Scores

Source	Sum of Squares	df	Mean Square	F	p	Partial Eta Square	Bonferroni Test
Between subjects	2569.37	1	38431	5.29*	.01	0.20	1-3*
Measure	67.8	2	33.9				
Error	204.8	32	6.4				
Total	2841.97	35	38471.3				

Since Mauchly's test of sphericity was significant according to Table 6 (W(2) = 0.546, p=.761), the Greenhouse-Geisser value was checked. In other words, there was a significant difference between at least two pairs of measurements. The Bonferroni test was conducted to determine from which test

means the difference occurred. According to this value, there was a significant difference in favor of the retention test between the total scores of the VPS pre-test and the retention test academic self-confidence sub-dimension of the control group students ($F(2,32)=2569.37$, $p<.05$).

The results of the repeated measures ANOVA test to determine whether there is a significant difference between the pre-test, post-test and retention total scores of the control group VPS scientificity sub-dimension are presented in Table 7.

Table 7
VPS Control Group Scientific Pre-Test, Post-Test and Retention Total Scores

Source	Sum of Squares	df	Mean Square	F	p	Partial Eta Square	Bonferroni Test
Between subjects	418.07	16	9281.2	1.23	.30	0.071	No difference
Measure	14.62	2	7.31				
Error	190	32	5.93				
Total	622.69	50	9294.44				

Since Mauchly's sphericity test (sphericity) was found to be significant according to Table 7 ($W(2)=0.794$ $p=.178$), the Greenhouse-Geisser value was checked. However, according to the ANOVA test for repeated measures, no significant difference was observed between the total scores of the students in the control group in the pre-test, post-test and the retention test 'scientificity' sub-dimension scores ($F(2,32)=418.07$, $p>.05$).

Friedman test results are presented in Table 8 to reveal whether there is a significant difference between the pre-test, post-test and retention total scores of the control group VPS responsibility sub-dimension.

Table 8
VPS Control Group Responsibility Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	P	z
Control	17	0.38	2	.83*	No difference

*p> .05

According to Table 8, there is no significant difference between the scores of the VPS pre-test, post-test and retention responsibility sub-dimension scores of the students in the control group ($p=.83$).

The Mann-Whitney U test results are presented in Table 9 to reveal whether there is a significant difference between the VPS post-test total scores of the students in the both groups.

Table 9
VPS Experimental and Control Group Post-Test Total Scores

Groups	N	Mean Rank	Sum of Rank	U	p
Experimental	15	20.17	302.5	72.5	.03
Control	17	13.26	225.5		

According to the test results, there is a statistically significant difference in favor of the experimental group ($U=72.5$, $p<.05$) between the experimental group's VPS post-test total scores (Median: 69) and the control group's total post-test scores (Median: 56).

The Mann-Whitney U test results are shown in Table 10 to reveal whether there is a significant difference between the total scores of the VPS academic self-confidence sub-dimension post-test scores of the students in the experimental group and the total scores of the VPS post-test of the students in the control group.

Table 10
Post-Test Total Scores of the Academic Self-Confidence Subscale of the VPS Experimental and Control Groups

Groups	N	Mean Rank	Sum of Rank	U	p
Experimental	15	20.5	307.5	67.5	.02
Control	17	12.97	220.5		

According to the test results, there is a statistically significant difference in favor of the experimental group between the total scores of the experimental group VPS academic self-confidence sub-dimension post-test (Median:35) and the control group's academic self-confidence sub-dimension post-test total scores (Median:29) (U=67.5), p< .05).

To reveal whether there is a significant difference between the post-test total scores of the students in the experimental group, the 'scientificity' sub-dimension of VPS and the total scores of the post-test of the students in the control group, a t-test was conducted for the independent samples. A Levene test statistic (F=2.14; p>.05) was conducted to test the homogeneity of the distribution of the experimental group and control group VPS 'scientificity' sub-dimension post-test total scores distribution, which concluded that the variances were homogeneous.

Table 11
Total Post-Test Scores of the VPS Experimental and Control Group Scientificity Sub-Dimension

Groups	N	$\bar{X}$	S	df	t	p
Experimental	15	14.9	4.1	30	1.54	.13
Control	17	13	2.9			

There was no significant difference between the total scores of the VPS post-test ($\bar{X}$=14.9) of the students in the experimental group and the total scores of the VPS post-test ($\bar{X}$=13) of the students in the control group (t(30)=1.54, p>.05).

The Mann-Whitney U test results are presented in Table 12 to reveal whether there is a significant difference between the total scores of the VPS responsibility sub-dimension post-test scores of the students in the experimental group and the total scores of the VPS post-test of the students in the control group.

Table 12
Total Post-Test Scores of the VPS Experimental and Control Group Responsibility Sub-Dimension

Groups	N	Mean Rank	Sum of Ranks	U	p
Experimental	15	18.3	274.5	100.5	.29
Control	17	14.9	253.5		

According to the test results, there is no statistically significant difference between the experimental group's VPS responsibility sub-dimension post-test total scores (Median:18) and the control group's VPS responsibility sub-dimension post-test total scores (Median:18) (U=100.5, p>.05).

Findings Related to Problem Solving

T-test results for independent samples are presented in Table 13 to reveal whether there is a significant difference between PSI post-test total scores of students in the experimental group and PSI post-test total scores of students in the control group.

Table 13
PSI Experimental and Control Group Post-Test Total Scores

Groups	N	$\bar{X}$	S	df	t	p
Experimental	20	32.4	5.3	39	1.45	.15
Control	21	29.7	6.6			

There was no significant difference between the PSI post-test total scores ($\bar{X}$=32,4) of the students in the experimental group and the post-test total scores ($\bar{X}$=29,7) of the students in the control group (t(39)=1.45, p>.05).

ANOVA test results for repeated measurements are presented in Table 14 to reveal whether there is a significant difference between the PSI pre-test, post-test and retention total scores of the experimental group.

Table 14
PSI Experimental Group Pre-Test, Post-Test and Retention Total Scores

Source	Sum of Squares	df	Mean Square	F	p	Partial Eta Square	Bonferroni Test
Between subjects	1330.98	19	70.05				
Measure	85.3	2	42.65	4.86 *	.01	0.20	1-2*
Error	333.36	38	8.77				
Total	1749.64	59	121.47				

According to Table 14, because Mauchly's test of sphericity (sphericity) was significant (W(2)=5.55 p=0.6), the Greenhouse-Geisser value was checked. F value (F(4.86)=42.65, p<.05) was found to be significant as a result of the variance analysis. This result means that at least one pair is significantly different from zero among the experimental group pre-test, post-test and retention test averages. In other words, there is a significant difference between at least two pairs of measurements. The Bonferroni test was conducted to determine from which test means the difference stems. As a result of the paired comparison test, it was observed that the difference between pre-test and post-test averages was significant in favor of the post-test. The difference between post-test and retention test averages was not found to be significant.

Findings Related to Attitudes towards Mathematics

Mann Whitney U test results are presented in Table 15 to reveal whether there is a significant difference between the AtMS post-test total scores of the students in the experimental group and the AtMS post-test total scores of the students in the control group.

Table 15
AtMS Experimental and Control Group Post-Test Total Scores

Groups	N	Mean Rank	Sum of Rank	U	p

Experimental	20	22.25	445	185	.51
Control	21	19.81	416		

According to the test results, there was no statistically significant difference between the total AtMS post-test scores of the experimental group (Median: 56.5) and the control group's total AtMS post-test scores (Median:52) (U=185, p>.05).

Friedman test results are presented in Table 16 to reveal whether there is a significant difference between the MPL pre-test, post-test and retention total scores of the experimental group.

Table 16
AtMS Experimental Group Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	p	z
Experimental	20	0.781	2	.67*	No difference

*p> .05

According to Table 16, it was found that there was no significant difference between the pre-test, post-test and retention total scores of the students in the experimental group (p= .67, p>.05).

Findings Regarding Academic Achievement

T-test results for independent samples are presented in Table 17 to reveal whether there is a significant difference between the AAT post-test total scores of the students in the experimental group and the AAT post-test total scores of the students in the control group.

Table 17
AAT Experimental and Control Group Post-Test Total Scores

Groups	N	$\bar{X}$	S	df	t	p
Experimental	20	12.6	5.1	39	-0.98	.54
Control	21	13.5	13.5			

There was no significant difference between the AAT post-test total scores ($\bar{X}$=12,6) of the students in the experimental group and the AAT post-test total scores ($\bar{X}$=13,5) of the students in the control group (t(39)=-.98, p>.05).

Friedman test results are presented in Table 18 to reveal whether there is a significant difference between the AAT pre-test, post-test and retention total scores of the experimental group.

Table 18
AAT Experimental Group Pre-Test, Post-Test and Retention Total Scores

Group	N	Friedman X^2	df	p	z		p
					Post/Pre	-3.45	.001**
Experimental	20	20.36	2	0.00*	**Retention /Pre**	-3.48	.00**
					Retention/Post	-1.11	.265

* p< .05 ** p< .0167

There is a significant difference in favor of the post-test between the AAT pre-test, post-test and retention total scores of the students in the experimental group (p=.034, p<.05). According to the Wilcoxon test, which was conducted to reveal in which groups there was a significant difference, between the pre-test and the post-test was in favor of the post-test (z=-3.45, p<.05) and between retention and the pre-test in favor of retention (z=3.48, p<.05), it is understood that there is a significant difference. In addition, the absence of a significant difference between the post-test and retention total scores (p>.0167) indicates that there is retention.

Discussion and Conclusion

In this study, the effect of values-based instructional activities on students' mathematics achievement, value perceptions, problem-solving skills, attitudes towards mathematics and retention in middle school 6th grade MPL was investigated. The findings indicate that, for the experimental group, the MPL activities that incorporated values education, contributed to increases in student value perceptions**.** In addition, the effect of MPL activities incorporated by values education delivered to the experimental group was also observed on the academic self-confidence value of the students. In addition, the findings show that there is retention in value perceptions and self-confidence values. However, the effect of MPL activities applied to the experimental group on students' scientificity and responsibility value is not observed. In the control group, the current MPL activities applied to students did not affect students' value perceptions. Therefore, it may be argued that while MPL activities incorporated by values education are effective in improving perceptions of value and academic self-confidence value, MPL activities existing in current curriculum have no effect.

Kunduroğlu's (2010) study indicated that values education integrated with primary level curriculum provides a meaningful increase in the acquisition levels related to the values that were embedded within the curriculum. In another study conducted by Herdem (2016), it was observed that there was a significant difference between the post-test scores of the students in the experimental and control groups. From these findings, it was concluded that the students in the experimental group were more successful in obtaining information about values as a result of value teaching activities than the students in the control group. Duer, Parisi, and Valintis (2002) observed an increase in the value levels of students as a result of having a curriculum specifically designed to deliver values education. As a result of the applications in different fields related to the values determined in the studies conducted in the literature, a significant difference was found in favor of the post-test between the pre-test and post-test scores of value perceptions (affective characteristics, value levels, moral maturity, etc.) (Aladağ, 2009; Arabacı & Akgül, 2013; Ateş, 2014; Balcı, 2008; Bozkurt, 2017; Dilmaç, 1999; Dilmaç, 2007; Duer et al., 2002; Engin, 2014; Ergün, 2013; Erikli, 2016; Izgar, 2013; İpekçi, 2018; İşcan, 2007; Katılmış, Ekşi & Öztürk, 2011; Keskinoğlu, 2008; Kunduroğlu, 2010; Mazman Budak, 2012; Öztürk Samur, 2011; Sapsağlam, 2015; Seke, 2000; Sözkesen, 2015; Turhan Türkkan, 2017).

It may be posited that MPL activities incorporated by values education and existing MPL activities in current curriculum do not have any effect on improving the value of 'scientificity and responsibility'. Within the scope of the research, one aim was to give students three values (responsibility, academic self-confidence and scientificity) in a seven-week experimental process. While an increase was observed in the students' total VPS scores and academic self-confidence sub-dimension, there was no increase in the scientificity and responsibility dimensions. It is acknowledged that affective education is a process that takes a long time, and values are not acquired as easily, nor in a short time, as cognitive skills. In this respect, it may be interpreted that the seven weeks within the scope of the research did not provide sufficient time required to gain all three values. Supporting this interpretation is Aydemir Özbay's (2019) research, who observed that responsibility value activities combined with the mathematics curriculum did not cause a change in students' value gains, and, according to the quantitative and qualitative findings obtained with real-life mathematics activity, this included no substantial gains for the three-week responsibility value. İşcan (2007) reported that the values of universalism and benevolence were gained after a 17-week practice. Erikli (2016) states that while values education applied for six weeks is effective for 'respect, cooperation, honesty, friendship, and sharing' values, it is not effective in changing the responsibility value. Sapsağlam (2015) applied the social values curriculum for 13 weeks and concluded that the curriculum was effective in social skills acquisition. Engin (2014) observed an increase in four values with 13 weeks of practice. Using scientific dilemma forms that the students received after the mathematics curriculum, Çelebi (2020) found that a scientificity value integrated with the mathematics curriculum produced significantly higher scores than those obtained in the pre-measurement. Öztürk Samur (2011) observed an increase in the values following a three-month values curriculum. Similarly, Mazman Budak (2012) observed improvement in aesthetic value attitude levels following 10-weeks of instruction. Ada (2016) applied the values curriculum based on creative drama for 13 weeks and determined that the scores in the value control rubric of the program positively correlated to post-test scores in the experimental group. Akgül (2014) observed that after a 12-week web-based values education students' values of

justice and honesty increased. Aladağ (2009) employed an eight-week responsibility value unit inside a Social Studies Lesson and found a significant difference had emerged in favor of the experimental group's use and understanding of values. Likewise, Aktaş and Bozdoğan (2016), found that activities integrated with a 5 week "human and environment" unit improved the value of compassion positively in the experimental group. By contrast, Uzunkol (2014), employed a five week values curriculum based on respect and responsibility in life studies teaching and found that the program did not affect self-esteem. Dilmaç (2007) brought five values to the experimental group in 14 sessions. Kunduroğlu (2010) found a significant difference in favor of the post-test between the pre-test and post-test scores of the experimental group regarding three values as a result of the six-week values training practice.

In this study, activities were developed to teach the concepts of whole numbers (Numbers and Operations unit) and algebraic expressions (Algebra unit). According to Şahin and Başgül (2018), the number of social values being taught differed between the two units, with more values being present in the 'Numbers and Operations' learning field, and fewer in the "Algebra" learning field. As a result of preliminary studies conducted in this experiment, the social values of responsibility, scientificity and academic self-confidence were taken into account. According to Şahin and Başgül (2018), the most common social values in the 6th grade textbook were love and responsibility, while the least important social values were tolerance, kindness, respect, benevolence, solidarity and universalism. However, according to Sayın, Orbay and Altunay Şam (2019), there were inconsistencies in the amounts and types of values between units within 5th grade mathematics textbooks. Based on the evidence produced in these studies, closer attention to the inclusion of values based education is required when developing and organizing middle school mathematics textbooks.

The hypothesis that "MPL activities incorporated by values education" increase students' problem-solving skills was further incorporated by evidence from retention tests indicating MPL activities positively impacted student problem-solving skills. Similarly, Uzunkol (2014) found that social programs positively affected problem-solving skills after employing an integrative five-week curriculum, focused on teaching the values of respect and responsibilities, that embedded value-based learning within lesson plans designed for a course on life studies. In this study, although the difference between the PSI pre-test and post-test mean scores of the experimental group was significant in favor of the posttest, no significant difference was observed between the PSI posttest total mean scores of the experimental group and the control group. The reason for this may be that the current MUD activities did not improve the problem solving skills of the students. As stated in the MPL Curriculum, MPL is a lesson developed for students to experience and and engage with have problem-solving learning scenarios (MONE, 2013). Therefore, the increase in problem-solving skills of both the control group, who were given current/traditional MPL activities, and the experimental group, who were given MPL activities incorporated by values education, was an expected result.

Another result that emerged from the findings was that "MPL activities incorporated by values education" had no effect on students' attitudes towards mathematics. By contrast, Mazman Budak's (2018) research found that values-based activities had a positive significant difference in the attitudes of the students towards the social studies lesson. Similarly, students who participated in the values curriculum developed by Tarakçı (2013) had an increase in positive attitudes toward Turkish lessons.

Anxiety and attitude have an important place among affective characteristics (Baykul, 2009). In the classroom context, students may experience anxiety and stay away from math activities for fear of making mistakes, failing, and being socially ostracized (Altun, 2008). Taş (2016) found a significant difference between the experimental and control groups, with the experimental group having more positive attitudes associated towards values. In addition, Bıçak and Aşılıoğlu (2017) found that student attitudes towards mathematics significantly predicted mathematics achievement and had a positive effect on mathematics achievement. The results of Karagözoğlu's (2005) research underlines the consistency in which students choose elective lessons in line with their interests and abilities. The findings from this study found that the most preferred elective lesson was MPL, suggesting that the merging of values based education to mathematics curricula can align with, and possibly even amplify, student interests, abilities, and positive attitudes for mathematics.

While MPL activities are being prepared, it is aimed to increase students' interest in mathematics and to develop positive attitudes towards mathematics. Related studies also show that students have fun during their MPL activities (Akay, Çırakoğlu & Yanar Hancı, 2016; Erdem & Genç, 2014). In this study, the experimental and control group students consisted of students who took the MPL lesson in the previous academic year, leading to the conclusion that some of their positive attitude towards mathematics are at least partially predicated on prior classroom experiences with MPL.

In recent years, we have seen the importance of values education as a counterweight to an overall increase in societal violence and criminality, the weakening of the family as an institution where values are learned and passed on to future generations, a decrease in work ethics, as well as changes in the technological and social environments that structure the lives of young people (Aydın & Akyol Gürler, 2014). Based on the results from the retention tests in the research, this study further argues that 'MPL activities incorporated by values education' can contribute to the academic achievement of students, as well as to affective development. Similarly, Katılmış et al. (2011) determined that the character education curriculum positively affected both the acquisition of values and an increase in academic achievement. As a major study (Bloom, 1979; cited in Baykul, 2009) indicate that approximately one-quarter of the variations between individuals' learning comes from affective characteristics. When reviewing all of the currently available research concerning the integration of values education with different subject domains, it is clear there are a plethora of values based lesson plans currently being employed in Turkish education. This is particularly true when considering research focused on the implementation of values based lesson plans found in social studies, history, life science, RCaMK, and Science and Technology classrooms. Yet, with the exception of a few examples in a 2017 Ministry of National Education draft curriculum (MoNE, 2017), there exists a dearth of similar research that is focused on the implementation of values education within the field of mathematics. Just as it is important to teach students Mathematics and Turkish lessons, it is also necessary to teach values (Aydın & Akyol Gürler, 2014). The Ministry of National Education attaches great importance to values education in primary and secondary schools both with its current curriculum and values education practices. However, while RCaMK and Social Studies are handled in a detailed and planned manner in the curriculum, it is seen that there is no certain standard related to values education in the curriculum of other courses or that values education is not clearly reflected in other courses until 2017 (Köylü, 2016).

As Durmuş (2004) has suggested, the inclusion of values should be taken into consideration at every stage of the development of mathematics curricula by everyone from textbook authors to academic contributors and classroom teachers. Here, classroom teachers may play a particularly important role in curriculum design, classroom implementation, and assessment. For example, of the mathematics teachers interviewed for a study performed by Deniz (2018), a majority of them felt that values education was insufficiently included in the updated curriculum. Compounding the problem of values education curricula design and development are issues of content selection. According to Yıldız's (2019) research, textual and visual content in 5th grade mathematics textbooks are comprised mostly of nationalistic patriotic slogans that emphasize the values of responsibility, scientificity, self-control, equality, honesty, responsibility and helpfulness in 7th grade; connectivity, equality and helpfulness in 8th grade. One minor difference was found in the 6th grade, where the value of establishing a connection was emphasized, while many values, such as love and peace, are not included. A similar evaluation of middle school mathematics textbooks show that they are also very limited in terms of expressing values. Thus, one issue with content selection concerns a deference to instrumental rationality; where the means justify the ends and none of the ends are fundamentally concerned with, or connected to, the principal functions of values education, namely, to imbue the student with an understanding and appreciation for the values of individual and social peace.

In conclusion, this study focused on the relationship between mathematic activities and the affective adoption of values by middle school students. The selection of mathematics as a particular area of content was specific due to the fact very little research has been done that brings the teaching of mathematics in to relation with multiple variables, including the use of activities to teach values. The results of the study indicate that values based education can be delivered through a mathematics curriculum focused on activities that motivate students to think about mathematics as a set of practices that are in relation to, not divorced from, the social world of values. Due to the originality of

this research, it is expected to be an important resource for researchers, curriculum developers, and the Ministry of National Education, as well as to serve as a springboard for further research.

Considering the research results, the following recommendations are made:

(1) Mathematics activities incorporated by values education may be developed by Mathematics and curriculum development experts, and resources may be prepared for teachers to apply these activities.

(2) This research shows that value perceptions may be improved in all lessons, regardless of numerical or verbal distinction. Therefore, while developing curricula, topics related to values education may be included in different curricula, with a clear, creative and broad perspective of the concept of value may be instilled in students.

(3) This research included two sub-learning fields (Integers and Algebraic Expressions) in the 6th grade Mathematics curriculum. It is also limited to three values (responsibility, academic self-confidence and scientificity). It was observed that the activities developed in this study did not affect scientific and responsibility values. Activities may be developed in different sub-learning areas where these values may be developed (for example; sub-learning areas such as generating research questions for scientific value, data analysis, measuring fluids, etc.).

(4) In a seven-week experimental implementation process, three values (responsibility, academic self-confidence and scientificity) were specified in all activities. While the effect of the experimental application on the value perceptions and academic self-confidence of the experimental group students was observed; its effect on scientific and responsibility values was not observed. The research may be repeated with a new plan in which the experimental application process is longer and the number of activities is increased according to the duration.

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