



# The effect of the brain-based environmental education program applied to 5-6 years of pre-school children on their sustainable environmental behaviors

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## Abstract

The study aimed to determine the effect of a brain-based environmental program for preschool children aged 5-6 years on their sustainable environmental behaviors. For this purpose, an experimental study was designed for a period of 8 weeks. The participants of the study were composed of 20 children from middle socio-economic level families who attend two branches of a kindergarten in the province of Kütahya. Out of those 20 children, 10 were in the experimental group and 10 in the control group. The program applied to the experimental group was prepared by the researchers considering the principles of the brain-based learning approach. The 16 activities prepared for pre-school children were finalized by taking expert opinion from 5 experts in the field of pre-school education. The classrooms where the activities were implemented were arranged according to brain-based learning (such as heat, light, visual materials), fruits and drinking water were kept at the activity tables in order to meet the glucose and water needs of the brain, which are important in brain-based learning and that the brain needs for learning. Relaxation exercises were carried out and classical music was provided during all activities. Activities were held outside whenever the weather conditions are suitable. In the control group, the activities were prepared by the researchers according to the achievements in the 2013 Preschool Program of the Ministry of Education (MoNE). In the pretest and posttests, the "Environmentally Sustainable Behavior Assessment Scale for 60-72 Months-Old Children" developed by Özkan, Tuğluk and Yiğitalp (2019) was used. The scale consists of 20 items, consciousness and awareness, and 2 sub-dimensions. The scale is a 5-point Likert-type scale and is filled by the child's teacher for each child. Cronbach Alpha value of the scale; It is .92 for the awareness sub-dimension, .94 for the consciousness sub-dimension, and .92 for the whole scale (Özkan, Tuğluk & Yiğitalp, 2019). The results revealed that there was a significant difference between the pretest and posttest scores of the experimental group, and the posttest scores of the experimental and control groups.

**Keywords:** Brain-based learning, environmental education, sustainability, preschool

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## 1. Introduction

2. In the 21st century, which is called the information age, changing society needs, scientific and technical changes, economic factors make the necessity of some

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qualifications inevitable in individuals. Changes in science, education and society increase the expectations from the education system day by day, and it becomes more important to train human resources suitable for the needs of the age. One of the most important problems of humanity is how the most permanent and effective learning occurs (Alugar, 2021).

In technical terms, learning is the interaction between the neuro-chemical networks that control the human brain, which is expressed as the control center. It is thought that it is important to recognize the strengths of the brain for academic and emotional success. This knowledge of brain-based learning is an essential element of teaching to motivate individuals to be successful in school and life.

In the early childhood, the basic environment of the child's micro system is first the family and then the educational institutions. When this is the case, it is accepted that early childhood education is an important and critical stage in a child's life. The first stage of the school, "preschool education" is called a period of time in which the cognitive, language, socio-emotional, motor and self-care skills that cover the period from the birth of the child to the basic education stage and prepare the child for the future life are completed and shaped significantly.

Early childhood education, which is accepted as the critical years of life, is an important stage in which the skills, emotions and attitudes that will be with us throughout our lives are formed. Like basic knowledge, skills and attitudes gained in early childhood, the acquisition of knowledge about the environment and the development of attitudes towards the environment begin to take shape in early childhood and affect the environmental behavior of individuals in the following years (Grodzinska Jurczak, Stepska, Nieszporek, & Bryda, 2006; Taşkın and Şahin, 2008). At this stage, the ecological environment and sustainable environmental awareness begin to take shape from an early age. Creating conscious awareness of environmental awareness in children's little brains is an important step in terms of early intervention for a sustainable environment and livable futures.

When the preschool education is examined in terms of historical process, nature and child have been discussed together since ancient times.

When new developments in the field of Science and Education are followed closely, it is known that OECD closely monitors studies on the brain. In this direction, it has been funding research on the brain since 1999. Scientists have obtained important information for realizing great differences in education through various imaging techniques and many tests that they use in their studies in which they investigate the brain according to functional and structural criteria. OECD, "Educators do not recognize the brain of the student whose brain they want to change." Based on his idea, he started the "Understanding the Brain and Towards New Learning Sciences" projects. These

meaningful studies focused on in-class education processes, learning styles, mathematics, science and art studies of the findings about how knowledge, skills and attitudes are coded by the brain. Brain-based learning, created by Caine and Caine (1991) in line with these studies, includes how the working principles of the brain are for meaningful learning, and the organization of teaching in accordance with these principles in cognition.

According to Kaufman et al. (2008, pp. 52-53), the following points should be considered in educational environments where brain-based learning approaches will be used.

- A technique and framework for the teaching content should be established,
- content should be divided into units that can be directly or indirectly measured and easily understood,
- the active participation of the individual in the learning and teaching process should be ensured,
- All students should be provided with the opportunity to choose the learning path and style that suits them, inside and outside the classroom,
- A system based on teacher-student interaction but in which the student is in the center should be adopted.

This study is important both in terms of understanding the effects of brain-based environmental activities on the sustainable behavior of children, and the emergence of such activities that can guide and model the educators working in this field, and create alternatives in this direction. Therefore, the main purpose of this research is to examine the effect of brain-based environmental activities on the environmental sustainability behavior of preschool children.

## **2. Method**

### *2.1. Research design*

In the study, it was aimed to determine the effect of a brain-based environmental program applied to preschool children aged 5-6 years on environmental sustainability behaviors of children. For this purpose, an experimental model with pretest-posttest control group was used.

### *2.2. Determination of Experimental and Control Groups*

In an 8-week experimental study conducted to examine the effect of the Brain-Based Environmental Education Program on sustainable behaviors, 20 children from

middle socio-economic level families who attend two branches of a kindergarten in the province of Kütahya were studied. The socio-economic levels of the families of the children; It was determined on the basis of the district where the school is located, the price of the school, and the information received from the children's teachers according to the education level and income status of the parents. 10 of these children were in the experimental group and 10 of them were in the control group. Experimental and control groups were determined by collecting the names of the children in two branches and choosing among them by impartial assignment. Meanwhile, the names of the children were put in a bag and their names were drawn from the bag one by one, one child was selected to the experimental group and one child to the control group. In order to determine whether the groups differ in terms of their sustainable behaviors towards the environment, the "Scale for Evaluating Sustainable Environmental Behaviors for 60-72 Months-Old Children" was applied as a pretest in both groups. While the environmental education program based on brain-based learning was applied to the experimental group during the research, the activities prepared according to the achievements in the MONE 2013 Preschool Program were applied to the control group by the researcher.

### *2.3. Data collection tool*

In the research, the "Scale for Evaluation of Sustainable Environmental Behaviors for 60-72 Months-Old Children" developed by Özkan, Tuğluk and Yiğitalp (2019) was used. The scale consists of 20 items, consciousness and awareness, and 2 sub-dimensions. The scale is a 5-point Likert-type scale and is filled by the child's teacher for each child. Cronbach Alpha value of the scale; It is .92 for the awareness sub-dimension, .94 for the consciousness sub-dimension, and .92 for the whole scale (Özkan, Tuğluk & Yiğitalp, 2019).

### *2.4. Brain Based Environment Program*

The program was prepared by the researchers considering the principles of the brain-based learning approach. The 16 activities prepared for pre-school children were finalized by taking expert opinion from 5 experts in the field of pre-school education. The classrooms where the activities were implemented were arranged according to brain-based learning (such as heat, light, visual materials), fruits and drinking water were kept at the activity tables in order to meet the glucose and water needs of the brain, which are important in brain-based learning and that the brain needs for learning. relaxation exercises were carried out and classical music was listened during all activities. Activities were held outside when the weather permits. In the control group, the activities prepared according to the achievements in the MEB 2013 Preschool Program were applied by the researcher.

### 3. Results

In order to examine the effects of brain-based environmental effects on children's sustainable behaviors in 5-6-year-old children, the data obtained from the Environmentally-Oriented Sustainable Behaviors Assessment Scale for 60-72 Months-Old Children, which was applied to test the effectiveness of the education program, were examined. Before the analysis of the data, the mean, median and peak values of the data, the coefficients of kurtosis and skewness and the results of the Shapiro-Wilk test were examined in order to examine whether the data showed a normal distribution. Statistics of these examinations are presented in Table 1.

Table 1. Statistics of the Experimental and Control Groups Obtained from the Scale for Evaluation of Sustainable Environmental Behaviors for 60-72 Months-Old Children

		$\bar{X}$	X <sub>mean</sub>	X <sub>peak</sub>	Kurtosis	Skewness	Shapiro-Wilk		
								Statistics	p
CONTROL GROUP	Awareness Lower Dimension- Pre-test	7.50	8.00	8.00	-.52	-.45	.87	.10	
	Consciousness Lower Dimension– Pre-test	6.70	6.50	6.00	-1.24	.04	.87	.11	
	Total – Pre-test	14.00	14.00	14.00	1.19	-.99	.84	.05	
	Awareness Lower Dimension- Post-test	7.20	7.50	8.00	-1.81	-.47	.76	.00	
	Consciousness Lower Dimension– Post-test	6.60	6.50	6.00	-.15	.78	.78	.01	
	Total – Post-test	14.20	14.00	14.00	.89	1.08	.91	.27	
EXPERIMENTAL GROUP	Awareness Lower Dimension- Pre-test	7.60	8.00	8.00	2.05	-1.66	.65	.00	
	Consciousness Lower Dimension– Pre-test	6.60	6.50	8.00	-.79	-.54	.87	.09	
	Total – Pre-test	14.20	14.00	14.00	-.42	-.44	.89	.15	
	Awareness Lower Dimension- Post-test	9.80	10.00	10.00	-.71	-.66	.85	.06	
	Consciousness Lower Dimension– Post-test	8.70	9.00	9.00	4.77	-2.28	.53	.00	
	Total – Post-test	18.50	19.00	19.00	-.47	-.84	.83	.04	

When Table 1 is examined, considering that the sample consists of 20 people and a multiple evaluation is made in this direction, it is seen that the control group pretest total scores, posttest awareness subscale scores and posttest awareness subscale scores; It was observed that the experimental group pre-test awareness sub-dimension scores and post-test awareness sub-dimension scores diverged from the normal distribution (Pallant, 2015). As a result of this decision, data analysis was started.

### 1. Comparison of Experimental and Control Group Pre-test Scores for the Awareness Sub-dimension of the Scale for Evaluating Sustainable Environmental Behaviors for Children aged 60-72 months

The Mann Whitney U test was used to determine whether there was a significant difference between the pre-test scores of the awareness sub-dimension of the children in the experimental and control groups. The Mann Whitney U results of the children's pre-test awareness scores according to the experimental and control groups are given in Table 2.

Table 2. Mann Whitney U Results of Children's Pre-Test 60-72 Months-old Children's Assessment of Environmentally Sustainable Behaviors Scale Awareness Sub-Dimension Scores According to Experimental and Control Groups

Group	N	Order Total	Order Mean	X <sub>mean</sub>	U	Z	p
Control Group	10	102.50	10.25	8.00	52.50	-.22	.86
Experimental Group	10	107.50	10.75	8.00			
Total	20						

When the Mann Whitney U results given in Table 2 were examined, it was seen that there was no statistically significant difference in the pre-test awareness scores of the children between the experimental group (X<sub>mean</sub>=8.00, n=10) and the control group (X<sub>mean</sub>=8.00, n=10), U= 52.50, Z= -.22, p=.86. When the mean rank is examined, it can be said that the children in the experimental group have higher awareness scores, but it can be stated that this difference is not statistically significant.

## 2. Comparison of Experimental and Control Group Pre-test Scores for the Consciousness Sub-dimension of the Scale for Evaluating Sustainable Environmental Behaviors for Children aged 60-72 months

T-Test for Independent Samples was conducted to determine whether there was a significant difference between the pre-test scores of the consciousness sub-dimension of the children in the experimental and control groups. The T-test results showing the differences in the pre-test consciousness scores of the children between the experimental and control groups are given in Table 3.

Table 3. T-Test Results of Children's Pre-Test 60-72 Months-old Children's Environmentally-Oriented Sustainable Behaviors Evaluation Scale Consciousness Scores According to Experimental and Control Groups

Group	N	$\bar{X}$	SS	sd	t	p
Control Group	10	6.70	1.06	18	.18	.86
Experimental Group	10	6.60	1.43			
Total	20					

When the results of T Test for Independent Samples given in Table 3 are examined, it is seen that there is no statistically significant difference between the children's pre-test Consciousness sub-dimension scores between the control group ( $\bar{X}=6.70$ ) and the experimental group ( $\bar{X}=6.60$ ),  $t(18) = .18$ ,  $p=.86$ . When the mean scores of the groups are examined, it is seen that the children in the control group have higher consciousness scores, but it can be stated that this difference is not statistically significant.

## 3. Comparison of Experimental and Control Group Pre-Test Scores for the Total Scores of the Scale for Evaluating Sustainable Environmental Behaviors for 60-72 Months-Old Children

Mann Whitney U test was used to determine whether there was a significant difference between the pretest scores of the total scale scores of the children in the experimental and control groups. The Mann Whitney U results of the children's pre-test total scores according to the experimental and control groups are given in Table 4.

Table 4. Mann Whitney U Results of Children's Pre-Test Scores of the Scale for Evaluating Sustainable Environmentally Responsible Behaviors for 60-72 Months-Old Children According to Experimental and Control Groups

Group	N	Order Total	Order Mean Score	$X_{\text{mean}}$	U	Z	p
Control Group	10	99.00	9.90	14.00	56.00	.48	.68
Experimental Group	10	111.00	11.10	14.00			
Total	20						

When the Mann Whitney U results given in Table 4 were examined, it was seen that there was no statistically significant difference between the experimental group ( $X_{\text{mean}}=14.00$ ,  $n=10$ ) and the control group ( $X_{\text{mean}}=14.00$ ,  $n=10$ ) in the pre-test total scores of the children,  $U= 56.00$ ,  $Z= .48$ ,  $p=.68$ . When the mean rank is examined, it is seen that the children in the experimental group have higher total scores, but it can be said that this difference is not statistically significant.

#### 4. Comparison of the Pre-Test and Post-Test Scores of the Children in the Control Group of the Awareness Sub-Dimension of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children

Wilcoxon Signed Ranks test was used to determine whether there was a significant difference between the pre-test and post-test scores of the children in the control group in the awareness sub-dimension. The Wilcoxon Signed Ranks test results according to the awareness sub-dimension pretest and posttest scores of the children in the control group are given in Table 5.

Table 5. Wilcoxon Signed Ranks Test Results According to the Pretest and Posttest Scores of the Awareness Sub-dimension of the Scale for the Assessment of Environmentally Sustainable Behaviors for 60-72 Months-old Children in the Control Group

Test	N	$X_{\text{mean}}$	Z	p
Pre-test	10	8.00	-1.00	.32
Post-test	10	7.50		
Total	20			



When the Wilcoxon Signed Rank Test results given in Table 5 were examined, it was seen that there was no statistically significant difference between the awareness sub-dimension pre-test ( $X_{\text{mean}}=8.00$ ) and post-test ( $X_{\text{mean}}=7.50$ ) scores of the children in the control group,  $Z= -1.00$ ,  $p= .32$ . When the median values are examined, it can be said that although there is a decrease in the pre-test and post-test awareness scores of the children in the control group, this decrease is not statistically significant.

### **5. Comparison of the Pre-Test and Post-Test Scores of the Children in the Control Group of the Consciousness Sub-Dimension of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children**

Wilcoxon Signed Ranks test was used to determine whether there was a significant difference between the pre-test and post-test scores of the children in the control group. The Wilcoxon Signed Ranks test results according to the consciousness sub-dimension pretest and posttest scores of the children in the control group are given in Table 6.

Table 6. Wilcoxon Signed Ranks Test Results According to the Pre-Test and Post-Test Scores of the Consciousness Sub-dimension of the Scale for Evaluating Environmentally Sustainable Behaviors for 60-72 Months-old Children in the Control Group

<b>Test</b>	<b>N</b>	<b><math>X_{\text{mean}}</math></b>	<b>Z</b>	<b>p</b>
Pre-test	10	6.50	-.29	.77
Post-test	10	6.50		
Total	20			

When the Wilcoxon Signed Rank Test results given in Table 6 were examined, it was seen that there was no statistically significant difference between the consciousness sub-dimension pre-test ( $X_{\text{mean}}=6.50$ ) and post-test ( $X_{\text{mean}}=6.50$ ) scores of the children in the control group,  $Z= -.29$ ,  $p= .77$ .

### **6. Comparison of Pre-Test and Post-Test Results of the Total Scores of the Children in the Control Group of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children**

Wilcoxon Signed Ranks test was used to determine whether there was a significant difference between the pre-test and post-test results of the children in the control group. The Wilcoxon Signed Ranks test results according to the pretest and posttest results of the total scores of the children in the control group are given in Table 7.

Table 7. Wilcoxon Signed Ranks Test Results According to the Total Score Pre-Test and Post-Test Results of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children in the Control Group

<b>Test</b>	<b>N</b>	<b>X<sub>mean</sub></b>	<b>Z</b>	<b>p</b>
Pre-test	10	14.00	-.17	.87
Post-test	10	14.00		
Total	20			

When the Wilcoxon Signed Rank Test results given in Table 7 were examined, it was seen that there was no statistically significant difference between the total scores of the children in the control group, pre-test (X<sub>mean</sub>=14.00) and post-test (X<sub>mean</sub>=14.00) scores, Z= -.17, p=. 87.

### **7. Comparison of the Pre-Test and Post-Test Scores of the Children in the Experimental Group on the Awareness Sub-Dimension of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children**

Wilcoxon Signed Ranks test was used to determine whether there was a significant difference between the pretest and posttest scores of the Awareness subscale scores of the children in the experimental group. The Wilcoxon Signed Ranks test results according to the Awareness sub-dimension pre-test and post-test scores of the children in the experimental group are given in Table 8.

Table 8. Wilcoxon Signed Rank Test Results According to Pre-Test and Post-Test Scores of the Awareness Sub-dimension of the Scale for Evaluating Environmentally Sustainable Behaviors for 60-72 Months-old Children in the Experimental Group

<b>Test</b>	<b>N</b>	<b>X<sub>mean</sub></b>	<b>Z</b>	<b>p</b>
Pre-test	10	8.00	-2.70	.01
Post-test	10	10.00		
Total	20			

When the Wilcoxon Signed Rank Test results given in Table 8 were examined, it was observed that there was a statistically significant difference between the Awareness sub-dimension pretest ( $X_{\text{mean}}=8.00$ ) and posttest ( $X_{\text{mean}}=10.00$ ) scores of the children in the experimental group,  $Z= -2.70$ ,  $p=. 01$ . It was observed that the said difference had a large ( $r=.60$ ) effect size. When the median values are examined, it can be said statistically that there was an increase in the pre-test and post-test awareness scores of the children in the control group, that is, the program applied increased the awareness levels of the children.

### **8. Comparison of the Pre-Test and Post-Test Scores of the Children in the Experimental Group on the Consciousness Sub-Dimension of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children**

The Wilcoxon Signed Ranks test was used to determine whether there was a significant difference between the pre-test and post-test scores of the children in the experimental group in the Consciousness sub-dimension of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-Old Children. The Wilcoxon Signed Ranks test results according to the consciousness sub-dimension pretest and posttest scores of the children in the experimental group are given in Table 9.

Table 9. Wilcoxon Signed Ranks Test Results According to the Pre-Test and Post-Test Scores of the Consciousness Sub-dimension of the Scale for Evaluating Environmentally Sustainable Behaviors for 60-72 Months-Old Children in the Experimental Group

<b>Test</b>	<b>N</b>	<b><math>X_{\text{mean}}</math></b>	<b>Z</b>	<b>p</b>
Pre-test	10	6.50	-2.57	.01
Post-test	10	9.00		
Total	20			

When the Wilcoxon Signed Ranks Test results given in Table 9 were examined, it was seen that there was a statistically significant difference between the Consciousness sub-dimension pre-test ( $X_{\text{mean}}=6.50$ ) and post-test ( $X_{\text{mean}}=9.00$ ) scores of the children in the experimental group,  $Z= -2.57$ ,  $p=. 01$ . It was observed that the said difference had a large ( $r=.57$ ) effect size. When the median values are examined, it can be said statistically that there is an increase in the pre-test and post-test consciousness scores of the children in the experimental group, that is, the education program raises the consciousness levels of the children (Baştürk, 2016).

### 9. Comparison of Pre-Test and Post-Test Results of the Total Scores of the Children in the Experimental Group of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-old Children

In order to determine whether there is a significant difference between the pre-test and post-test results of the total scores of the children in the experimental group, T-test for Dependent Groups was performed. T-test results for Dependent Groups according to the pre-test and post-test results of the total scores of the children in the experimental group are given in Table 10.

Table 10. T-Test Results for Dependent Groups According to the Total Score Pre-Test and Post-Test Results of the Scale for the Assessment of Sustainable Environmental Behaviors for 60-72 Months-old Children in the Experimental Group

Test	N	$\bar{X}$	SS	sd	t	p
Pre-test	10	14.50	1.40	9	-6.44	.00
Post-test	10	18.50	1.35			
Total	20					

When the results of T Test for Dependent Samples given in Table 10 are examined, it is seen that there is a significant difference between the total scores of the children in the experimental group, pre-test ( $\bar{X}=14.50$ ) and post-test ( $\bar{X}=18.50$ ) scores,  $t(9)=-6.44$ ,  $p=.00$ . When the mean values are examined, it can be said statistically that there was an increase in the pre-test and post-test total scores of the children in the experimental group, that is, the education program increased the total scores of the children. When the effect size of the said difference was examined, the eta-square value was calculated as .82.

### 10. Comparison of Experimental and Control Group Post-Test Scores for the Awareness Sub-Dimension of the Scale for Evaluating Sustainable Environmental Behaviors for Children aged 60-72 months

The Mann Whitney U test was used to determine whether there was a significant difference between the post-test scores of the awareness sub-dimension of the children in the experimental and control groups. The Mann Whitney U results of the children's post-test awareness scores according to the experimental and control groups are given in Table 11.

Table 11. Mann Whitney U Results of Children's Post-Test 60-72 Months-old Children's Assessment of Environmentally Sustainable Behaviors Scale Awareness Scores According to Experimental and Control Groups

Group	N	Order Total	Order Mean Score	$X_{\text{mean}}$	U	Z	p
Control Group	10	60.00	6.00	7.50	95.00	3.50	.00
Experimental Group	10	150.00	15.00	10.00			
Total	20						

When the Mann Whitney U results given in Table 11 were examined, it was seen that there was a statistically significant difference between the experimental group ( $X_{\text{mean}}=15.00$ ,  $n=10$ ) and the control group ( $X_{\text{mean}}=6.00$ ,  $n=10$ ) in the post-test Awareness scores of the children,  $U= 95.00.$ ,  $Z= 3.50$ ,  $p=.00$ . When the mean rank is examined, it can be said that the children in the experimental group have higher Awareness scores. When the effect size of this difference is examined, it is seen that it has a large ( $r=.78$ ) effect size.

### 11. Comparison of the Experimental and Control Group Post-Test Scores for the Consciousness Sub-Dimension of the Scale for Evaluating Sustainable Environmental Behaviors for Children aged 60-72 months

The Mann Whitney U test was used to determine whether there was a significant difference between the post-test scores of the children in the experimental and control groups of the Consciousness sub-dimension. The Mann Whitney U results of the children's post-test Consciousness scores according to the experimental and control groups are given in Table 12.

Table 12. Mann Whitney U Results of Children's Post-Test 60-72 Months-old Children's Assessment of Environmentally Sustainable Behaviors Scale Awareness Scores According to Experimental and Control Groups

Group	N	Order Total	Order Mean Score	$X_{\text{mean}}$	U	Z	p
Control Group	10	58.50	5.85	6.50	96.50	3.69	.00
Experimental Group	10	151.50	15.15	9.50			
Total	20						

When the Mann Whitney U results given in Table 12 are examined, it is seen that there is a statistically significant difference between the experimental group ( $X_{\text{mean}}=9.50$ ,  $n=10$ ) and the control group ( $X_{\text{mean}}=6.50$ ,  $n=10$ ) in the post-test Consciousness scores of the children,  $U= 96.50$ ,  $Z= 3.69$ ,  $p=.00$ . When the mean rank is examined, it can be said that the children in the experimental group have higher consciousness scores.

## 12. Comparison of Experimental and Control Group Post-Test Scores for the Total Scores of the Scale for Evaluating Environmentally Sustainable Behaviors for 60-72 Months-old Children

In order to determine whether there is a significant difference between the post-test scores of the children in the experimental and control groups, the T-test for Independent Groups was conducted. T-test results for Independent Groups according to the experimental and control groups of the children's post-test total scores are given in Table 13.

Table 13. T-Test Results of Children's Post-Test Total Scores According to Experimental and Control Groups for Independent Groups

Group	N	$\bar{X}$	SS	sd	t	p
Control Group	10	14.20	1.81	18	-6.01	.00
Experimental Group	10	18.50	1.35			
Total	20					

When the T-test results for Independent Groups given in Table 13 are examined, it is seen that there is a statistically significant difference in the post-test total scores of the children between the experimental group ( $\bar{X}=18.50$ ,  $n=10$ ) and the control group ( $\bar{X}=14.20$ ,  $n=10$ ). ,  $t(18)= -6.01$ ,  $p=.00$ . It can be said that the children in the experimental group had higher total scores from the scale after the training program than the children in the control group. The effect size of the said difference was calculated as  $\eta^2=.67$ . Accordingly, it can be stated that approximately 67% of the variance observed in the posttest total scores obtained from the scale depends on the experimental and control groups. In addition, the calculated Cohen d value is 2.69. This result also shows that the difference between the mean post-test scores of the experimental and control groups from the scale is 2.69 standard deviations (Büyüköztürk, 2020).

#### 4. Discussion

Considering the results of the study, a significant difference was found between the posttest scores of the experimental and control group children and the pretest and posttest scores of the experimental group children (they got from the sub-dimensions of the scale and all). This shows us that the implemented brain-based environmental education program is effective. There was no difference between the pretest and posttest scores of the control group.

Recent studies have focused on human, learning and the basic components of the brain (Bonomo, 2017). There are many principles and in-class regulations that teachers must comply with in order for learning to take place. (Willis, 2007). Environmental factors are important in terms of the learning process and the effectiveness of learning. For this reason, there are some factors that must be taken into account in order to create a suitable classroom atmosphere. These can be listed as oxygen, light-temperature, color, nutrition-water, movement, smell, music-rhythm (Küçükkaragöz, 2014). Attention should be paid to the fact that the walls of the classroom are painted in colors or colors that facilitate learning, the presence of visual stimuli in the classroom and the seating arrangement (Schiller & Willis, 2008). Brain-based learning is an approach that activates all parts of the brain during learning. There is an increase in student achievement in schools that implement this approach (Bucayong et al., 2020).

There are studies in the literature examining the effect of brain-based learning on academic achievement (Özden,2005;Yücel,2011;Akyürek&Afacan,2013;Ekemen,2017). In addition, Hoge (2002) concluded in his research using the brain-based learning method that brain-based teaching techniques help primary school students develop positive literacy experiences. Özkan (2015), in his study examining the effect of brain-based science education program on the scientific process skills of preschool children, stated that there was a significant difference in favor of the experimental group in the post-test scores of the experimental and control groups. Duman and Köksal (2019) examined the effect of brain-based learning activities on primary school readiness and concluded that brain-based learning has a positive effect.

There are experimental studies in the literature in which environmental education is given with different methods and approaches and its effects are examined. Kurt Gökçeli (2015) stated that there was a significant difference between the experimental and control groups in favor of the experimental group in his study, in which he examined the effect of the Environmental Education Program on the environmental awareness of 48-66 month-old children. Karimzadegan (2015) conducted a study with the environmental education program to help preschool children acquire positive attitudes towards the environment and increase their environmental knowledge. In a study conducted by Hsiao

and Shih (2016), it was stated that children who were given environmental education through picture books improved paper, electricity and water savings. Altuntaş (2021), in his research that aims to examine the effects of environmental education based on documentary-based augmented reality applications on critical thinking dimensions and science literacy in environmental problems, determined that documentary-based augmented reality applied environmental education increases critical thinking disposition, critical thinking skills and science literacy in environmental problems. . In his research, Kükürt (2021) prepared art activity plans related to environmental issues and implemented a program based on project-based teaching method. These studies are experimental studies that show the importance of environmental education. However, a study using the brain-based learning approach has not been found in the literature.

## **5. Conclusions and Suggestions**

According to the results obtained from the research findings, it has been concluded that brain-based environmental activities have a positive effect on the sub-dimensions of consciousness and awareness, which are in the sub-dimensions of the scale of sustainable environmental behavior for 60-72 months old children.

In the light of the findings obtained from the research, the following suggestions can be given to the researchers.

- Brain-based learning is a learning approach that has proven effective in both domestic and international literature. However, when we examine the studies on pre-school education in our country, it is seen that there are few studies. For this reason, it may be recommended to investigate the effects of the brain-based approach in experimental studies.
- Considering the effect of brain-based learning on academic achievement, it can be recommended to design and organize learning environments in a way that is brain-friendly.
- It is important to teach environmental education and sustainability behaviors from pre-school. It can be recommended to develop environmental education programs for pre-school children.



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