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The Effect of Interdisciplinary and Sensory-Based Programs on Preschool Children's Acquisition of the Concepts of Living and Non-Living Things

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ABSTRACT

Children's understanding of living and non-living concepts is usually interpreted by a child's degree of cognitive development. However, many studies with a different methodology include biological characteristics demonstrating that young children can distinguish between living and non-living. This research aims to examine the effect of the interdisciplinary and sensory-based education program prepared for preschool children on acquiring living and non-living concepts. A mixed method design was used, involving pre-test and post-test. Seventy-eight children, including 38 in the experimental group and 40 in the control group, participated. An education program was developed and applied to the experimental group for eight weeks. A designed questionnaire was used to collect data. According to the results, a significant difference ($p < 0.05$) existed between the pre-test and post-test of the experimental group scores of plant and non-living categories, but in the animal category, no significant difference ($p > 0.05$) was evident. In the scores of the human category, only five-year-old children's scores were found statistically significant ($p < 0.05$). The children with interdisciplinary sensory-based education explained the living and non-living things primarily through biological characteristics (growth, nutrition, and breathing). These differences were not observed in the control group expressions.

***Keywords*:** preschool children, sensory-based education, living and non-living concepts

Concepts are essential in our perception and interpretation of the world. They are abstract representatives of classifications of objects, events, ideas, and behaviors. Concepts organize thoughts (Kurt, 2020) and improve learning (Hayran, 2010). Conceptualization is a cognitive skill and is a process of abstraction. During conceptualization, individuals associate their new experiences with their old ones and knowledge, and while making this association, they use synthesis, classification, and linguistic skills (Borghi et al., 2019; Stavy & Wax, 1992). According to some researchers, concept learning can explain psychological perspective and focuses on how cognitive conceptualization occurs (Brainerd, 1977; Carey, 1985; Piaget, 1929; Speece & Brent, 1984). Some researchers find the explanation in the framework of science education (Bretz, 1994; Develay, 1992; Giordan & DeVecchi, 1987). Studies focus on strategies (De Cecco, 1968; Klausmeier, 1992; Merrill et al., 1992) and models (Bhagat et al., 2016; Gilbert, 2010; Holbrook et al., 2022) of concept teaching.

Concept learning starts early and is conducted in a planned manner within the formal education system. Concepts not adequately formed at the right time can negatively affect the learning processes of children and even adults (Gordon, 1996). Children are thought to complete their lack of theoretical knowledge with misconceptions (Noureddine & Zouhaire, 2017; Ozgur, 2018; Yagbasan & Gulcicek, 2003). Incorrectly learned concepts can sometimes cause new concepts to be learned improperly. Therefore, it is necessary to evaluate and support children's concept development in their early life stages. Preschool education is fundamental and critical. During this period, children are curious and more sensitive about their environment (French, 2004). The concept development of a child gains a more systematic structure during the preschool period.

Interdisciplinary and Sensory-based Education as a Teaching Concept

A particular scientific discipline does not shape preschool children's concepts; they perceive concepts as a whole (Yurttas et al., 2020). Therefore, learning activities within preschool can be designed to take an interdisciplinary approach. The National Academy of Science (2004) defines interdisciplinarity as "a mode of research by teams or individuals that integrates information, data, techniques, tools, perspectives, concepts, and/or theories from two or more disciplines or bodies of specialized knowledge to advance fundamental understanding or to solve problems whose solutions are beyond the scope of a single discipline or area of research practice" (p.26). In interdisciplinary learning, the teaching contents are much more engaging and relevant. This approach helps develop children's thinking skills and helps them learn and explore many complex ideas (Dinuta, 2015). Moreover, it adds fun to children's lives and learning without being limited to disciplinary knowledge (Bhise, 2020). Studies in preschool education also illustrate that this approach is useful (Cengizhan & Balci, 2022; Convertini, 2020; Gulay-Ogelman & Durkan, 2014).

In order for concept learning to occur, first of all, observations and experiences should be realized. Children's concept acquisition through experiences can only occur when they use all their senses in their observations, enabling them to connect the objects and events (Suryaratri & Prayitno, 2019). The number of sensory organs involved in learning eases concept acquisition (Fleming & Levie, 1979; Tan & Temiz, 2003). Sensory-based activities allow children to explore their environment using more senses (Tekerci & Kandir, 2017). Sensory-based education is an approach to helping children develop their skills and knowledge from the first years of their lives (Besir, 2020; Uyanik Balat et al., 2005; Yaswinda & Yulsyofriend, 2019). This step increases the child's mental capacity and expands their abstract-thinking skills (Cosgrove & Ballou, 2006). According to Celik (2010), "It is known that the information and skills are perceived more easily and take place in the human brain more permanently via the approaches that appeal to more than one sense" (p. 779). Hence, one can say that sensory-based education creates a more successful learning process than other teaching approaches (Shams & Seitz, 2008). This phenomenon occurs when the studies conducted with this educational approach are primarily used in educating disabled children (Henry, 1998; Yildirim Dogru & Cetingoz, 2017) or language education (Birsh, 2005; Hayran, 2010). Some studies addressed preschool children's environmental perceptions (Ozdemir & Uzun, 2006; Xu et al., 2022; Yaswinda & Yulsyofriend, 2019), scientific process skills (Tekerci & Kandir, 2017; Yaswinda, 2016), development of sensory experiences (Besir, 2020), and creative thinking skills (Koyuncuoglu, 2017). Yaswinda and Yulsyofriend (2019) studied the cognitive skills of 4–5 years old children and reported increased cognitive skills by implementing a project approach in science learning based on multisensory-ecology. Xu et al. (2022) revealed that visual, auditory, tactile, and olfactory sensations were significantly ($p<0.05$) correlated with children's behavioral experiences aligning with these results.

Children's Conceptions about Living and Non-Living Things

One of the essential concepts taught in science education during preschool is the concept of living and non-living things. In education, living and non-living things are usually regarded as concepts showing children's cognitive development levels (Piaget, 1929; Laurendeau & Pinard, 1962; Rosengren et al., 1991; Backscheider et al., 1993). Piaget's (1929) research on movement criteria is the most critical research on children's cognitive development and concept of living things. Many researchers following Piaget's theory also argues that children cannot distinguish it before age 10 (Laurendeau & Pinard, 1962; Jahoda, 1958; Bayraktar & Kuvvet, 2017; Ozgur, 2018; Ozturk & Tulum, 2021). However, studies conducted afterward showed that children benefit from many biological characteristics ((1) growth, (2) reproduction, (3) respiration, (4) nutrition, (5) excretion, (6) irritability, and (7) locomotion) while explaining the concept of living (Carey, 1985; Gasparatou et al., 2020; Gelman et al., 1983; Hatano & Inagaki, 1997; Leddon et al., 2009; Looft, 1974; Margett-Jordan et al., 2017). These studies illustrate that children have intuitive biological knowledge through observation and apply it when asked to classify objects as living or non-living. These researchers accentuate that teaching these concepts at an early age must be based on the biological characteristics of living things. Inagaki and Hatano (1996), in their research with 5-year-old children, proved that children made fewer mistakes when the questions were based on biological characteristics (nutrition, growth, etc.). In parallel, Gasparatou et al. (2020) saw that children aged between 4 and 5 had no difficulty defining living and non-living things using biological features after participating in "Philosophy for Children" as a learning environment.

The concept of living and non-living things is a vital science study subject. Despite being educated about the concept, young children have difficulty attributing the characteristics of life to a particular object. Studies have revealed that human beings are the first to emerge as the concept of living things, animals the second, and plants the third (Laurendeau & Pinard, 1962; Richards & Siegler, 1984; Yorek et al., 2009). These studies posed that children of all age groups had difficulty identifying plants as living things and considered them conceptually living things in the real sense between ages 6 and 7. However, Inagaki and Hatano (1996) conducted a study with children aged between 4 and 5 based on biological characteristics and used growth from biological characteristics. They found that children could classify plants as living things. The research conducted on nature and pollution by Tarman and Kent Kukurtcu (2022) with the same age group of children demonstrated similar results.

The literature review demonstrates that existing data seem controversial due to the complexity of the concept, the methodologies, and the research contexts (Zogza & Papamichael, 2000). However, it seems possible for preschool children to learn the concepts of living and non-living things with adequate educational intervention (Bakar et al., 2020; Gasparatou et al., 2020). The acquisition of the living concept occurs when the biological characteristics of plants, animals, and humans can be generalized to all living things. It is necessary to include observations by which children can recognize and distinguish biological characteristics while developing language skills effective in acquiring concepts.

Our study aims to determine whether the interdisciplinary and sensory-based education program affects learning the concepts of living and non-living things in children aged 5 to 6 years. The following research questions were sought:

- Is there any difference between the acquisition of the concept of living and non-living things in the experimental and control group children before and after the application of an interdisciplinary and sensory-based education program?
- Is there any statistically significant difference between the experimental and control groups' pre-test and post-test mean scores?
- Is there any statistically significant difference between the experimental group's pre-test and post-test mean scores?
- Is there any difference between the expressions used by the experimental and control group children to describe plants, animals, humans, and non-living things before and after the educational program?

METHOD

The study was designed in a mixed research model combining qualitative and quantitative data. Experimental research was conducted with a pre-test-post-test control group model. The experimental and control groups were randomly distributed, and a data collection tool was administered to the participants before and after the education.

Study Group

In this study, two groups were formed with 5-year-olds (48–60 months) and 6-year-olds (60–72 months) as experimental groups and two other groups as control groups, also divided into the same age groups. The study participants comprised 78 preschool children, with 38 in the experimental and 40 in the control group, attending two public preschool institutions located in Turkey. A consent form was sent to the families via the school administration, complying with the permission from the Minister of Education (B.08.4.MEM.07.20.02-605.01 / 11116). Children whose families agreed were included in the study.

Similarities of the experimental and control groups were evaluated with the questionnaire form used to increase the study’s internal validity and determine the effect of the education program. The results obtained from this evaluation showed no significant differences ($p > 0.05$) between the experimental and control groups.

Data Collection Tool

The data collection tool was a questionnaire developed by the researcher. The previous questionnaires applied to preschool and elementary school students were analyzed to determine the data collection process and the questionnaire format (Bahar et al., 2002; Lorenzi et al., 2013; Ozgur, 2018; Yesilyurt, 2003; Zogza & Papamichael, 2000). According to Ozcelik (1982), the most effective way to measure concept development is with words and visual forms closely related to the names of the concepts that need to be acquired. Color photographs and two open-ended questions were used in the questionnaire because color photographs are the closest materials to reality, and concrete pictures substantially increase credibility (Nalcaci & Ercoskun, 2005). Two education specialists and a preschool teacher selected the color photographs. The following questions were included: “What do you see in this picture?”, “Do you think it is alive, not alive?” “Why is it alive? Why is it not alive?” The questionnaire was presented to ten preschool children to test whether they were comprehensible.

Many studies accentuated that children's perceptions of life differ regarding the four categories: plants, animals, humans, and non-living things (Leddon et al., 2009; Ozturk & Tulum, 2021; Richards & Siegler, 1984; Yorek et al., 2009). Therefore, these four categories were considered to determine the education program's effectiveness precisely. The children's misconceptions, daily lives, school activities and usage in the previous studies were considered in selecting the things. In the final form of the questionnaire, the following categories were used; in the non-living category: robot, sun, moon, doll, and table; in the plant category: seed, violet, pine tree, carrot, and apple; in animal category: butterfly, snail, fish, chick, and cow; and human category: baby, child, adult, and old man pictures.

The Research Process

Before the experimental process, the questionnaire was applied as a pre-test to experimental and control groups. During the study, the concept of living and non-living things was taught in the experimental group with educational activities based on interdisciplinary and sensory-based education for eight weeks. However, the education was given following the Ministry of National Education’s instructions in the control group. At the end of eight weeks, the same questionnaire was used as a post-test, and the experimental process was finalized.

Design of Interdisciplinary and Sensory-based Education Program

An instructional design model helps educators organize their pedagogical activity optimally for their educational objective (Branch, 2009). Several models can be used in different settings, such as ADDIE (Analysis, Design, Development, Implementation, Evaluation), ASSURE (Analyze learners, State objectives, Select methods, Utilize media and materials, Require learner participation, and Evaluate), and the Dick, Carey and Carey model (Ozdemir & Uyangor, 2011). Among these models, the ADDIE was the most suitable for the present research’s purpose and characteristics. ADDIE approach model comprises five stages: analysis, design, development, implementation, and evaluation.

In the first stage, needs analysis, determination of the program's objectives, content, and subjects, and analysis of the existing research and student characteristics in the field were accomplished. The human resources and time planning were planned in the program's design phase. Subsequently, the topics to be included in the program, the objectives for these topics, and the teaching methods to be used were decided. While determining the program's goals, basic biological characteristics were considered, such as movement, growth, nutrition, respiration, and reproduction. These five vitality traits were chosen because they were basic, concrete, observable, and suitable for the children's cognitive development participating in education.

In the curriculum development phase, these themes were arranged according to teaching principles (Sunbul, 2010) and listed as a weekly theme. The activities were grouped into human, animal, plant, and non-living things. Determining activities for the five senses (smell, taste, touch, hearing, and sight) were prepared for each category. Each activity addressed one or more senses. Therefore, an interdisciplinary approach was considered. In addition, the program's goals and contents were also arranged according to the psychomotor, social-emotional, and language skills defined in the official curriculum in Turkey. Various methods and techniques were used to prevent uniformity in the activities. At each weekend, general activities supported the new theme learned. Table 1 depicts the weekly schedule of the education program. The sensory organ used in the activities was coded as S: Sight, H: Hearing, Sm: Smell, Tc: Tactile, and T: Taste. Afterward, the discipline of the activity was written: PD: Play and drama, Sn: Science-nature, V: Visual arts, and Tu: Turkish. Finally, numbers indicate the order of activity.

Table 1
Weekly plan of the education program

Week	Subject	Activities
1	General activities related to movement, nutrition, growth, respiration, and reproduction	SHPD1 Living or non-living? SmPD1 Sick Dog TcSnV1 Let us Touch HSn2 What sound? SPDV1 Hardworking Ants
2	Nutrition	TSn1 How does it taste? SPD1 Who ate it? SPD1 Where are the livings one? STu2 My Garden
3	Growth	SHSn1 From Caterpillar to Butterfly SHPD2 Dance with Butterflies SV1 I am making my Butterfly SPD2 Guess what
4	Movement	STPDSn1 What jumps? STPDSn2 Touch it, so it closes/turns off SHPD2 Fun Train SmTu2 Beautiful and Bad Smelling Plant
5	Respiration	STuSn2 Fish in the Classroom SHPD3 Let us Breathe SVSn1 My Respiratory Organs SmSn1 Scent Carts
6	Reproduction	SHTuSn Whose Cub? SPD3 Emperor Penguins SHSn2 How are babies made? SV2 Baby Animals Farm
7	General activities related to movement, nutrition, growth, respiration, reproduction	SPD4 Find Your Move SHV1 Animate or Inanimate Rolls SHSn3 Getting to Know the Animals

8	General activities related to movement, nutrition, growth, respiration, and reproduction	STcSn2 Sweating Flowers SmPDTu1 What Does This Corner Smell? STcSn1 Touch Living or Non-Living

The researcher regularly explained the activity outcomes and steps to the experimental group teachers during the application. The program was applied to the experimental groups for eight weeks, two days a week, at least 60 minutes a day, and at most 75 minutes. Evaluations were made at different times and for various purposes. The first of these tests was the questionnaire before and after the application to determine the children's progress. The second was the evaluation made with teachers to assess the application's deficiencies while the program was implemented.

Data Analysis

Quantitative data were analyzed using children's responses. The Kolmogorov-Smirnov test was used to check whether the difference between the pre-test and post-test total scores of the experimental and control groups was normally distributed. According to normality test values, the data belonging to the experimental and control groups of 5-year-olds [D (38) = 0.178, p > .05] and 6-year-olds [D (40) = 0.200, p > .05] were normally distributed because both p-values exceeded the critical value of 5%.

Before the education, the independent sample t-test was performed to determine if the two groups' concept levels were similar. The pre-test scores of 5-year-olds experimental and control group children were as follows: plant [t (38) =.28, p < .05], animal [t (38) =. 64, p < .05], human [t (38) = 1.60, p < .05], and non-living [t (38) =.49, p < .05]. Then the pre-test scores of 6-year-old experimental and control group children were the following: plant [t (40) =. 25, p < .05], animal [t (40) = 1.78, p < .05], human [t (40) =. 70, p < .05], and non-living [t (40) = .66, p <.05]. No significant difference (p>.05) was detected in the experimental and control groups' pre-tests.

Two-factor ANOVA was used to analyze the difference between the experimental and control groups' pre-test and post-test total scores. Single-factor ANOVA (repeated measures ANOVA) test was used to compare the experimental group's pre-test and post-test.

The questionnaire involved qualitative data from the questions "Why is it alive? Why is it not alive?" According to Bozkurt (2018, p. 7), conceptual development and the development of language skills function as a process of working separately and unitedly. Considering that concept learning and language skills develop together, the expressions used in education were assumed to describe living and non-living things. After the education program, they would also be improved. Therefore, content analysis methods were used. The interviews conducted with children were transformed into written texts. Two researchers read the answers and collected them under specific categories. Finally, the answers given were grouped into seven categories: movement, biological characteristics, behavior, physical characteristics and their relationship with the environment/living things, animism, and others. Table 2 depicts the examples.

Table 2
Sample answers for categories

Categories	Sample answers
Movement	Because it walks, because it moves, it cannot move.
Biological characteristics	Because it is growing, because it is being fed; as it has a baby, as it is not feeding, it does not have a baby.
Behavior	Because it talks, because it laughs because it feels pain.

Physical features	Because it has eyes, has no eyes, because it has feet, it has leaves, it has flowers.
Its relationship with the environment/living things	Because it is food, because birds eat it, it lives in the soil.
Animism	It has been sought only in expressions used when describing inanimate things: as it has eyes, as it has face, as it talks.
Other	Because I like it, as it is wood because I picked it because it is beautiful because it is old.

It is thought that the rapid development of preschool children may affect the study's validity. Internal validity was targeted by making post-test measurements immediately after the education, minimizing this effect.

Findings

Comparison of Experimental and Control Groups' Pre-test and Post-test

The data were collected separately for plant, animal, human, and inanimate pictures to compare the pre-test and post-test total scores. A Two-Factor ANOVA was performed to analyze the differences between the pre-test and post-test total scores of 5 and 6-year-old experimental/control groups, and Table 3 presents the results.

Table 3
ANOVA test results regarding experiment/control groups' pre-test and post-test scores

	Source	SS	Df	MS	F	p
Plant 5 y	Between Groups	21.053	1	21.053	9.345	.004*
	Within Groups	32.895	1	32.895	15.131	.000*
Plant 6 y	Between Groups	42.050	1	42.050	12.938	.001*
	Within Groups	28.800	1	28.800	10.190	.003*
Animal 5 y	Between Groups	3.368	1	3.368	.531	.471
	Within Groups	.000	1	.000	.000	1.000
Animal 6 y	Between Groups	5.000	1	5.000	3.279	.078
	Within Groups	.050	1	.050	2.000	.165
Human 5 y	Between Groups	14.329	1	14.329	9.308	.004*
	Within Groups	3.803	1	3.803	2.973	.093
Human 6 y	Between Groups	.112	1	.112	.456	.504
	Within Groups	.312	1	.312	1.179	.284
Non-living 5 y	Between Groups	16.118	1	16.118	2.281	.140
	Within Groups	1.066	1	1.066	6.025	.019*
Non-living 6 y	Between Groups	9.113	1	9.113	1.376	.248
	Within Groups	2.813	1	2.813	13.073	.001*

When one examines Table 3, the group effect was significant for the experiment and control groups' pre-test and post-test mean scores related to plant and non-living categories. This difference is primarily due to the difference between the average scores of experimental groups' pre-tests and post-tests. The same effect was also observed in the scores of the 5-year-old experimental and control groups regarding the human category.

No significant difference existed in pre-test and post-test scores regarding the animal category. Similarly, no significant differences existed between the pre-test and post-test measurements of 6-year-olds regarding the human category. Therefore, these results depict the effect of education on acquiring the concepts regarding the animal category for 5 and 6-year-olds. However, the human category for 6-year-olds was not statistically significant.

Findings Regarding the Comparison of Experiment Groups' Pre-test – Post-test Test Scores

One-factor ANOVA was performed to compare the experimental groups' pre-test and post-test; Table 4 illustrates the results.

Table 4

Findings of one-way ANOVA test results for 5 and 6-year-old experiment groups' pre-test and post-test

	Source of Variation	Sum of Squares	Degrees of Freedom	Mean Square	F	p
Plant 5-year-olds	Treatment	84.351	2	42.175	29.39	.000*
	Error	51.649	36	1.43		
	Total	172.14	56			
Plant 6-year-olds	Treatment	86.800	2	43.400	23.61	0.00*
	Error	69.867	38	1.839		
	Total	185.65	59			
Animal 5-year-olds	Treatment	0.105	2	0.053	0.073	0.93
	Error	25.895	36	0.719		
	Total	105.368	56			
Animal 6 y-year-olds	Treatment	0.233	2	0.117	0.241	0.79
	Error	18.433	38	0.485		
	Total	68.983	59			
Human 5-year-olds	Treatment	12.772	2	6.386	7.69	0.02*
	Error	29.895	36	0.83		
	Total	59.93	56			
Human 6 y-year-olds	Treatment	0.433	2	0.217	0.712	0.5
	Error	11.567	38	0.304		
	Total	18.933	59			
Non-living 5-year-olds	Treatment	14.982	2	7.491	9.741	.000*
	Error	27.684	36	0.769		
	Total	161.719	56			
Non-living 6 y-year-olds	Treatment	16.633	2	5.317	7.123	0.03*
	Error	39.367	38	1.562		
	Total	177.333	59			

$*p < .05$

Table 4 illustrates a significant difference between the experimental group children's pre-test and post-test about plants and non-living things. In addition, 5-year-old children's post-test mean scores ($\overline{X}$ =9.68) were higher than pre-test mean scores ($\overline{X}$ =7.15). Similar results were obtained for 6-year-olds. Children's post-test mean scores ($\overline{X}$ =9.65) were higher than their pre-test mean scores ($\overline{X}$ =7.15). No significant difference was found between children's pre-test and post-test in the animal category. The 5 year-old-children's pre-test ($\overline{X}$ =9.05) and post-test ($\overline{X}$ =9.10) values and 6-year-old children's pre-test ($\overline{X}$ =9.45) and post-test ($\overline{X}$ =9.5) values were close. A significant difference was found regarding the 5-year-old experimental group children's pre-test and post-test about the human category. Moreover, post-test ($\overline{X}$ =9.91) mean scores were higher than pre-test mean scores ($\overline{X}$ =7.36). No significant difference existed between the 6-year-old experimental group children's pre-test ($\overline{X}$ =9.68) and post-test ($\overline{X}$ =9.93) scores. All these findings pose that the experimental group children's acquisition of living and non-living concepts increased significantly for the post-test than the pre-test.

Findings Regarding the Expressions Used by Experiment and Control Group Children to Describe Living and Non-Livings Things

This section includes the findings obtained via the descriptive analysis method. Table 5 contains the analysis of the experimental and control group children's expressions to explain why plants were living or non-living things.

Table 5

Expressions used by children to define plants

Plant	5-year-olds				6-year olds			
	Experimental		Control		Experimental		Control	
	Pre %	Post %	Pre %	Post %	Pre %	Post %	Pre %	Post %
Movement	14	6	15	19	26	8	23	20
Biological characteristics	25	75	39	46	21	82	24	27
Behavior	5	13	11	7	4	5	5	5
Physical features	19	1	16	16	14	1	14	16
Its relationship with the environment/living things	21	3	18	10	22	10	28	29
Animism	-	-	-	-	-	-	-	-
Other	14	1	1	1	14	1	7	5

When the experimental and control group children's answers in the pre-test were examined, both groups were seen to use expressions belonging to the categories of "biological characteristics" (25%), "their relationship with living things" (21%), and "physical features" (19%). Within the answers in the category of biological characteristics, the statements were primarily related to "nutrition" and "growth."

When the post-test results of the experimental groups were examined, a significant increase was found regarding the expressions in the "biological characteristics" category (Age 5: 75%; Age 6: 82%). The same situation was not seen in the control group, and the difference between the pre-test and post-test percentage values was insignificant ($p>0.05$). The answers in the post-tests for this category were mainly related to "nutrition" and "growth," as in the pre-tests, followed by "respiration" and "reproduction." However, the expression "breathing" was not expressed in the pre-test. In the post-test of the experimental group, children used expressions such as "breathing," "breaths," and "breathes in and out" for plants.

Table 6 presents children's expressions in the experimental and control groups about why the animal was living or non-living things.

Table 6
Expressions used by children to define animals

Animal	5-year-olds				6-year-olds			
	Experimental		Control		Experimental		Control	
	Pre %	Post %	Pre %	Post %	Pre %	Post %	Pre %	Post %
Movement	36	18	50	60	42	18	41	37
Biological characteristics	18	74	13	7	21	70	10	13
Behavior	4	-	3	4	-	1	5	3
Physical features	34	6	16	23	17	6	27	28
Its relationship with the environment/living things	3	2	4	3	7	3	8	6
Animism	-	-	-	-	-	-	-	-
Other	5	-	14	3	13	2	9	13

When the answers by experimental and control group children in the pre-test were examined, different categories emerged regarding experimental and control group children's expressions about animals living or non-living. The common and prominent ones in the pre-tests were the categories of "movement" followed by "biological characteristics." When experimental and control group children's post-test results were examined, a significant increase was found in the expressions of the "biological characteristics" category for experimental group children (Age 5: 74%; Age 6: 70%). In addition, while expressions existed related to nutrition and growth in the pre-tests regarding living things belonging to the "biological characteristics" category, children also used respiration and reproduction concepts in post-tests. The same situation was not seen in the control group, and the answers given in the post-test did not differ markedly from the pre-tests.

Table 7 contains the children's expressions of why humans were living or non-living things.

Table 7
Percentage distributions of the expressions used by children while describing the humans

Human	5-year-olds				6-year-olds			
	Experimental		Control		Experimental		Control	
	Pre %	Post %	Pre %	Post %	Pre %	Post %	Pre %	Post %
Movement	32	23	31	40	31	21	40	36
Biological characteristics	12	70	13	9	15	60	6	12
Behavior	4	2	5	12	5	2	4	12
Physical features	43	5	35	26	34	6	40	25
Its relationship with the environment/living things	-	-	-	-	-	-	-	-
Animism	-	-	-	-	-	-	-	-
Other	9	1	16	13	15	1	10	15

Children’s answers in the pre-test were gathered in the “physical features” (Age 5: 43%; Age 6: 34%) and “movement” (Age 5: 32%; Age 6: 31%) categories in Table 7. The answers given in the post-test by the experimental group differed substantially. These differences were related to the category of “biological characteristics” (Age 5: post-test 70%; Age 6: post-test 60%). Children used growth, nutrition, reproduction, and respiration concepts. In this category, the pre-test and post-test answers of the control group did not change.

Table 8 contains the children’s descriptions of the pictures of non-living things.

Table 8

Percentage distributions of the expressions used by children while describing the non-living things

Non-living things	5-year-olds				6-year-olds			
	Experimental		Control		Experimental		Control	
	Pre %	Post %	Pre %	Post %	Pre %	Post %	Pre %	Post %
Movement	11	18	10	12	19	20	42	39
Biological characteristics	10	74	-	-	4	58	-	-
Behavior	16	1	19	-	22	5	22	16
Physical features	39	2	29	18	44	6	28	39
Its relationship with the environment/living things	4	-	6	39	-	-	-	-
Animism	10	5	10	8	10	1	7	5
Other	10	-	26	24	9	-	4	3

Their explanations in the pre-test regarding non-living things varied according to age and control and experimental groups. For example, 5-year-old experimental and control group children’s expressions were gathered in the “physical features” (Experiment: 39%; Control: 29%). The same category of “physical features” was formed for the 6-year-old experimental group (44%) and the 6-year-old control group children’s “movement” (42%). The expressions found in 5-year-old experimental and control group children’s answers in the pre-test (experiment: 10%; control: 10%) decreased in the 5-year-old children experimental group after the application (post-test: 5%; retention: 1%). In post-tests, children used “biological characteristics” to explain non-living things. It is because “no aspiration/it is not breathing,” “it does not have a baby,” “it is not growing,” and “it is not eating” were the expressions to show that non-living things did not have these characteristics.

Conclusion and Discussion

Using interdisciplinary and sensory-based education programs, we examined children’s acquisition of living and non-living things concepts. Furthermore, we divided the concept into four categories of plants, animals, humans, and non-living things to better detect the differences in conceptual learning. The results of the research are discussed below, considering these categories.

Children’s Recognition of Living and Non-living Things

No significant difference ($p > 0.05$) existed between the experimental group children’s answers to the pictures about plants regarding their pre-test and post-test scores. This result indicates that the experimental group children’s identification of plants as living things increased significantly in the post-test than in the pre-tests. This result differs from those in many studies conducted with children of this age group (Leddon et al., 2009; Yorek et al., 2009), even though these studies accentuated that the concept of living things for plants is acquired later (Opfer & Siegler, 2004). Applying interdisciplinary and sensory-based education programs demonstrated that children could develop these concepts early. They readily described plants as living things after the education-based biological characteristics. As a specific example, the grain was recognized as a living being, 9% for 5-year-olds and 11% for 6-year-olds before education. After education, children easily identified grains as living things (82% for 5-year-olds and 91% for 6-year-olds). This result aligns with previous research based on biological characteristics. In a study by Inagaki and Hatano (1996) on the concept of growth with 4 to 5-year-old children and another study conducted by Hickling and Gelman (1995) with the concepts of reproduction and growth through seeds, it was stated that after recognizing the characteristics of living things, children could more easily distinguish between living and non-living things.

The children's scores on the pre-test in the animal category were comparatively high, and the research results did not reveal a statistically significant difference. It depicts that children at this age could easily define animals as living things even before education. This result supports previous research findings that children recognize the animals' biological characteristics better than plants' (Keilen & Roy, 1995; Springer et al., 1996; Springer& Keil, 1991). Keilen and Roy (1995) asked children aged between 6 and 13 about the life situations and biological characteristics of animals and plants to examine the acquisition of life concepts. The results obtained in present research about animals and humans were due to children's interest in moving things (Piaget, 1929; Laurendeau & Pinard, 1962; Looft, 1974) and having pets (Hatano and Inagaki, 1994). Children naturally follow the development and skills of many animals with great curiosity.

When the answers belonging to the human category were examined, no significant difference ($p>0.05$) existed between the 6-year-old experimental group children's answers regarding pre-test and post-test scores. However, a significant difference (p-value?) was observed for 5-year-olds in the same category. Considering children's cognitive development, humans should be the first to emerge as a living thing, and animals should be the next (Yorek et al., 2009). Nevertheless, in the answers given in the pre-test, children defined animals as living things better than humans. This situation is thought to be caused mainly by children's reactions to images of older people and babies. Some children could not identify the older man with a cane and the sleeping baby alive. As justification, they stated that neither of them could walk. This result supports the studies' findings, accentuating that the movement feature is dominant in defining living things, especially for 5-year-old children (Piaget, 1929; Poulin-Dubois & Heroux, 1994).

Findings revealed that the experimental group children's acquisition of non-living things concept increased significantly ($p < .05$) in post-test than pre-test measurements. According to other research results, children make fewer mistakes when questioned about stones, toys, household appliances, and cars (Looft, 1974; Richards & Siegler, 1984). However, when children are asked about concepts such as clouds and rivers, children are seen to attribute living characteristics (animism) to them (Laurendeau & Pinard, 1962; Zogza & Papamichael, 2000). Research results in the non-living category aligned with many researchers studying living things' concepts (Inagaki & Hatano, 1996; Gutheil et al., 1998; Taborda-Osorio & Cheries, 2017). They found decreased children's misconceptions when questions and activities were based on biological characteristics (Hatano & Inagaki, 1994).

Children's Description of Living and Non-Living Things

Because concept acquisition and language skills develop together (Birsh,2005) the children participating in the research were also asked why they defined that as living or non-living. We checked whether a change occurred in their expressions after the education. When the experimental group children's answers in the pre-test for the plants, they primarily used the expressions belonging to the categories of "biological characteristics," "relationship with living things," and "physical features." Children used the physical features of plants as living things, similar to the other research results (Villarroel & Infante, 2014). In addition, the frequency of expressions used to explain biological characteristics increased significantly ($p < .05$) in the post-test. While in the category of biological characteristics in the post-test, more expressions about growth, reproduction, respiration, and nutrition concepts after the educational program were evident. For example, they used expressions related to respiration, such as "breathing," "breathing in and out," and "aspirates" for plants. This situation is thought to be caused by the activity of "evapotranspiration flowers" during education. Planting and irrigating the seeds, watching them grow, and observing the flowering process used growth, reproduction, and respiration concepts effectively while defining them as living things. These findings align with the studies of Hickling and Gelman (1995), examining the perspectives of 4-4.5-year-old children on the life cycle of the plant world. In this study, while taking the children's opinions about where the seeds originated, their perception of growth, flower, and fruit concepts was also examined by establishing causal connections. No misconceptions were determined about growth in plants. In the current education program, planting seeds and including plant-growing activities in the classroom allowed children to observe the changes.

These activities enabled them to benefit from the expressions of reproduction, respiration, and biological characteristics, such as growth and nutrition, in explaining plants as living things.

Results obtained from animal and human categories are similar. In the pre-test results of the 5 and 6-year-old groups, expressions were gathered under the categories of "movement" and "physical features." In some studies, children were said to define everything that moves as alive, and that movement was the first vitality characteristic that appeared in children's minds (Bahar et al., 2002; Laurendeau & Pinard, 1962; Poulin-Dubois & Heroux, 1994; Yorek et al., 2009). While describing animals and humans as living things, they also used physical features, such as "having hands and arms," "having eyes," and "having feet." It is because it is easier for children to use similarities between humans and animals. Carey (1985) stated that a learned feature about humans can easily be transferred to the animal world. Bahar et al. (2002) reported that children observed animals more daily. In the post-tests, expressions were gathered under "biological characteristics" and "movement." When the expressions used by the experimental group were examined, children benefited from the butterfly's movement feature to identify it in pre-tests. However, in the post-test, they also mentioned their biological characteristics, such as nutrition, growth, respiration, and reproduction.

Another remarkable example is fish. While explaining the fish as living things, children included nutrition and respiration more in their expressions after the educational program. For example, expressions such as "it has gills," "breathes in the water," and "aspirates" were encountered in the post-test. It is thought to be due to the "Fish in the classroom" and "Respiratory organs" activities, examining how fish and people breathe. In addition, the frequency of the expressions they used about why animals are living things doubled after the education.

When the expressions about non-living things were examined, the "physical features" category excelled in the pre-test. After the education, the expressions were gathered under "biological characteristics." While the animism category was seen in the pre-test, these expressions decreased in the post-test. The results obtained from the study's pre-test parallel those in many studies (Bahar et al., 2002; Noureddine & Zouhaire, 2017; Yesilyurt, 2003; Zogza & Papamichael, 2000). Bahar et al. (2002) determined that half of the preschool children considered the sun a living thing. The reason was the sun's movement (sunrise and sunset), heat, and sunlight. Noureddine and Zouhaire (2017) also identified the concept of movement as a major obstacle in teaching the living concept.

Yesilyurt (2003) conducted a study and found that children express the sun's physical features using expressions such as "it gives us heat and light." Moreover, evidently, while children argue that the sun is a living thing, they make statements about its biological characteristics. They said, "the sun was moving, breathing, and dying." While children belonging to both age groups defined the beings as non-living things after education, they used the biological characteristics by giving answers such as "the robot is not feeding," "not being able to grow," "not having a baby," and "not breathing." Therefore, they indicated that the things they learned during their education did not have the same characteristics as the ones shown. For instance, the results obtained for the robot concept in this study are similar to those in Inagaki and Hatano (1996). The researchers showed pictures of robots, plants, and dogs to 4–5-year-olds and asked which one could grow; the children chose the plant and dog pictures. Wellman and Gelman (1998) conducted a study with 3–4-year-old children and found that most could distinguish a living entity from its non-living copy. Rosengren et al. (1991) found that children understood that animals grew over time, but toys did not. In another study on the same theory, many children in the age group of 4 stated that plants and animals could heal and grow independently. However, those toys did not have this feature (Backscheider et al., 1993). According to post-test results, children described non-living things using expressions belonging to the "biological characteristics" category. The results obtained from the research demonstrate that when children's activities are based on biological characteristics, their misconceptions decrease.

In closing, interdisciplinary and sensory-based education is very effective in 5 and 6-year-olds' acquisition of living and non-living things concepts. Similarly, Yaswinda and Yulsyofriend (2019) also found an increase in the cognitive skills of 4–5-year-old children in multisensory-ecology projects. Mustonen et al. (2009) also stated the importance of multisensory education and the permanence of the behaviors and attitudes gained through this education.
Participation in more than one sense of the learning process makes learning more effective (Shams & Seitz, 2008). For example, Xu et al. (2022), in their study based on children's multisensory experiences, concluded that visual,

auditory, tactile, and olfactory senses are significantly related to children's behavioral experiences. Therefore, new teaching programs should be prepared for different concepts enabling preschool children to develop sensory skills and learn more effectively.

Unlike the studies following Piaget's approach of teaching the concept of living and non-living, in this research, no difference existed in concept acquisition between 5 and 6-year-olds after implementing multisensory education. This result poses that this concept can be acquired early. As Birsh (2005) and Bozkurt (2018) accentuated in their research, concept teaching, and language skills developed together, and new words were acquired easily. In this study, paralleling with the results of other studies (Gasparatou et al., 2020), children used more biological characteristics in their expressions after education. The average number of biological characteristics rose in the post-test, and their quality also improved. Our results suggest that interdisciplinary and sensory-based education should be applied in different areas of preschool education.

Statements and Declarations

We declare that there is no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

We state that the data was collected in accordance with the standards and guidelines of the human subjects review board (or equivalent body) at my home institution. All the required official permissions and ethics form were approved by the Ethics Committee at Antalya of Minister of Education (B.08.4.MEM.07.20.02-605.01 / 11116), a consent form was sent to the families via the school administration.

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