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The Investigation of the Effect of Science Education Program-Dramatic Activities (Sep-Da) on the Science Process Skills of 60–72-Month-Old Children

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Abstract

This study was conducted in a quasi-experimental design to examine the effect of science education given to 60-72-month-old children through dramatic activities on their science process skills. The study group consisted of two groups of 60-72-month-old children attending kindergartens and having similar social, cultural and economic characteristics. Pre-test, post-test and retention test scores were calculated using the Scientific Process Skills Test developed to evaluate children's scientific process skills. SEP-DA (Science Education Program-Dramatic Activities), which was planned for 7 weeks and 14 activities, was used for the experimental application. In the education program, science process skills were presented to children with drama techniques. At the end of the experimental process, the difference between the science process skills scores of the children in the experimental and control groups was found to be significant. The science education program given through dramatic activities had a strong effect on the science process skills of the children in the experimental group. The retention test also revealed that this effect was long lasting.

Keywords: creativity, drama, science process skills, science education.

Dramatik Etkinlikler Aracılığı ile Verilen Fen Eğitiminin (Sep-Da) 60-72 Ay Çocuklarının Bilimsel Süreç Becerilerine Etkisinin İncelenmesi

Öz

Bu araştırma, 60-72 aylık çocuklara dramatik etkinlikler yoluyla verilen fen eğitiminin bilimsel süreç becerilerine etkisini incelemek amacıyla yarı deneysel desende gerçekleştirilmiştir. Çalışma grubu, anaokullarına devam eden ve benzer sosyal, kültürel ve ekonomik özelliklere sahip 60-72 aylık iki grup çocuktan oluşmaktadır. Çocukların bilimsel süreç becerilerini değerlendirmek amacıyla geliştirilen Bilimsel Süreç Becerileri Testi kullanılarak ön test, son test ve kalıcılık testi puanları hesaplanmıştır. Deneysel uygulama için 7 hafta ve 14 etkinlik olarak planlanan SEP-DA (Fen Eğitim Programı-Dramatik Etkinlikler) kullanılmıştır. Eğitim programında bilimsel süreç becerileri çocuklara drama teknikleri ile sunulmuştur. Deneysel süreç sonunda deney ve kontrol grubundaki çocukların bilimsel süreç becerileri puanları arasındaki fark anlamlı bulunmuştur. Dramatik etkinlikler aracılığı ile verilen fen eğitim programı deney grubundaki çocukların bilimsel süreç becerileri üzerinde güçlü bir etkiye sahiptir. Kalıcılık testi de bu etkinin uzun süreli olduğunu ortaya koymuştur.

Anahtar kelimeler: yaratıcılık, drama, bilimsel süreç becerileri, fen eğitimi.

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INTRODUCTION

The preschool period, during which most of the child's development is completed at an important level, constitutes the foundation of life (Özkan, 2015). The knowledge, skills and experiences acquired during this period support children's emotional, mental, physical, linguistic and social development and enable them to prepare for life in the best way (Kale, 2019). Therefore, the education provided in the preschool period has permanent effects on children (Özbey and Alisinanoğlu, 2010). Children are individuals who can be original, express their feelings, have critical approach and a wide imagination (Bulut Üner, 2018). Therefore, by providing an educational environment in which they can use their five sense organs and be active, children should be given the opportunity to gain experience through practice (Güngör Seyhan, 2015). Science activities that support children's cognitive skills and allow them to observe, investigate and question can provide these opportunities (Aktaş Arnas, 2002). In the preschool period, children build the bridge between human, science and technology, through science (Özpir and Mantaş, 2018). Through science, they begin to consciously observe, examine, investigate and question their environment and make predictions and inferences (Karakuş, 2021). As children are curious, they use scientific skills almost every day by observing stones, animals, grass, trees, in short, everything living or inanimate on the earth and in the sky, while questioning the colors of the sea and blood, the reasons for the movement of clouds, which objects sink in water and which objects float, how ants walk or stand on the ground (Aktaş Arnas, 2002; MEB, 2013; Nuhoğlu, Ceylan, 2012; Özoğlu, 2020).

Science education in the preschool period provides children with information about science and nature, as well as scientific process skills such as learning about the environment, making assumptions, making inferences, and rational thinking (Kunt, 2016). Children comprehend sciences better by using their scientific process skills (Mutlu, 2012). Science education also enables children to use scientific process skills effectively and make observations and discoveries (Trundle and Sackes, 2015). Scientific process skills refer to all the skills used in determining a problem, making different assumptions in the face of the problem, obtaining information about it and reaching the result in line with the information obtained, following an observation and recognition of the environment (Yılmaz, 2017). On the other hand, scientific process skills are examined in two groups as basic process skills and integrated skills (Ayvacı and Yurt, 2016). While observation, comparison, classification, measurement, prediction, scientific communication and inference are sub-dimensions of basic process skills; determining and controlling the variables, forming and testing the hypotheses, planning and conducting the experiments, and interpreting data are among the sub-dimensions of integrated process skills (Bingöl and Ünal, 2019). Previous research idicate that, the integrated process skills follow the basic process skills, therefore, the basic process skills need to be acquired first (Kefi, 2018). The basic process skills are acquired during the preschool period, in direct proportion to the science education (Büyüktaşkapu, 2010; Öztürk, 2016). Acquiring these skills at an early age not only supports the child's sense of curiosity but also supports critical thinking and problem-solving skills. The acquisition of science concepts at this age also enables them to produce innovative solutions to complex problems at a later age (Lutfiani et al., 2021).

While science education in preschool period supports the development of scientific process skills, providing these trainings with interaction-based methods such as drama and play also affects the child's positive attitude (Sriwarthini et al., 2023).As a matter of fact, plants, animals, our body, our health, nutrients, liquids, landforms, natural phenomena, rocks, soil, seasons, simple gravity, matter, space, sound, light, motion-force-energy, temperature-heat, floating-sinking, discoveries, inanimate objects are examples of subjects of science in preschool education (Özoğlu, 2020). Additionally, in line with these subjects taught through science education, children gain the skills of observing by observing their environment through their sense organs; classifying the events and objects they observe by grouping them according to their characteristics; and measuring by expressing them numerically. They gain basic process skills such as recording data, recording the information they obtain about events and objects; predicting, making assumptions about the data they record; comparing, organising objects and events by considering their differences and similarities; inferring, evaluating and judging all the data they obtain (Behram, 2019; Tekerci & Kandır, 2017; Yaz, 2018). Science activities provide children with various skills such as learning through experience, being sensitive to their environment, establishing cause-effect relationships, reasoning, generating new ideas, being flexible, cooperating, expressing their ideas, being organized, and having self-confidence as well as scientific process skills (MEB, 2013). The acquisition of these skills is provided through a qualified science education, in other words, by creating a content-rich environment for children, ensuring their active participation and preparing child-oriented activities (Akyol, Birinci Konur, 2018; Saygılı, Ercan Yalman,

2021). According to Harlen (2013), the absence of science process skills in learning assessments will lead to dangerous neglect.

The way the knowledge and the skills are taught in preschool education is also very important (Gezgin and Kılıç, 2015). Especially in science teaching, since there are abstract or more difficult skills to comprehend, it is recommended to facilitate the process by choosing convenient methods for the teaching process (Can and Yıldırım, 2017). In this context, educators should encourage children to initiate and maintain the scientific process by creating a safe environment that increases children's productivity and allows them to research and investigate (Ünal and Akman, 2006). As a matter of fact, the skills necessary for scientific process skills are learned more easily by children in line with the methods, techniques, materials and activities preferred by educators (Ölçer and Aşıkoğlu Özdemir, 2018). Presenting science education with methods in which children actively participate in the process facilitates their acquisition of concepts. One of the methods that enable active participation and interaction of children in early years is drama (Curtis et al., 2013). In a discussion on creativity and thinking skills, Horikami and Takahashi (2022) stated that, creativity is revealed through the mutual exchange of thinking skills. Drama is one of the main creative learning methods that will enable children to learn easily (Kula, 2011). As in the definiton, "Drama; improvisation, role-playing, etc. is the interpretation and performance of an experience, an event, an idea, sometimes an abstract concept or a behavior, by way of the reorganization of old cognitive patterns and in 'playful' processes in which observations, practices, feelings and experiences are reviewed, using theater or drama techniques within a group work" the questioning process of the observations and experiences reflects its relationship with scientific process skills (Köse, 2018). Drama, which is included in preschool education, reveals the active power hidden in children (Akar Gençer and Akman, 2016). Thus, while children observe and analyze their environment through drama, they also gain experience by being active (Kara and Aslan, 2018). In addition to that, drama facilitates the acquisition of concepts in science by developing children's imagination and individuality (Kula, 2011). In addition to that, as a result of practicing science activities through drama, the individual assimilates information more easily by concretizing and experiencing abstract science concepts such as natural phenomena, heat, light, air, animals, plants, human voices (crying, laughing, angry, old, baby, sick people), using their sense organs (Altıntaş, 2012; Bakkaloğlu, 2017; Karaman Eflatun, 2021). In this context, including drama in science education facilitates science teaching that children acquire through their senses, as well as supporting their basic process skills such as observation, classification, comparing information, making assumptions and associating the acquired information in itself (Delihasanoğlu, 2021).

Children learn how to cope with the situations they encounter through drama, which is based on play (Bilgiş, 2019). The drama method involves presenting a problem from daily life to children and allowing them to explore it while also finding the cause of the problem, bringing a solution to the problem they find by acting it out (Can Yaşar, 2009). In this way, while investigating the problem, children actively use the skills of observation, by exploring their surroundings; classification, by grouping the results of observations in themselves; comparison, by analyzing the classified information according to their different and the same characteristics; making inferences, by making assumptions about the information they find and measuring, by putting all the results in numbers; in other words, the scientific process skills (Kefi, 2014). In this sense, drama differs from other teaching methods as it is based on interaction and life experiences and enables people to see the world from a different perspective (Adıyaman, 2019; Yıldırım, 2021). Stephenson (2023), based on a qualitative case study, states that, drama method increases creativity and well-being in the classroom, in comparison to national education systems. Additionally, while science education given to children through drama supports their basic process skills such as observation and prediction, it also prepares them for high-level scientific process skills such as hypothesizing, recognizing and controlling the variables and testing and interpreting data (Tan and Temiz, 2003). Therefore, gaining children science process skills through science activities in preschool period is very important (Başkan Takaoğlu and Demir, 2018).

Alternative science education programmes not only increase children's science achievement but also contribute to the development of science process skills. Teaching these skills through drama can provide a unique approach as it facilitates children's participation and attracts their attention. Thanks to its creative and multi-layered structure, integrating drama into science education will facilitate children's understanding of scientific concepts (Barakat, 2023). Considering that activities through drama develop scientific inquiry skills, it can be accepted as a method that encourages active learning (Kasbary, 2024). Practicing science activities through drama method both facilitates science teaching and provides the acquisition of scientific process skills, the prerequisites for learning science (Yıldırım, 2021; Aksan & Çelikler, 2016). Therefore, this study focuses on the preschool period, where the effect of teaching science through dramatic activities on scientific process skills has been less studied.

Considering this framework, this study aimed to determine the effect of science education given to 60-72-month-old children through dramatic activities on their science process skills. In line with this objective it is aimed to;

- Create a science education program delivered through dramatic activities
- Investigate the effect 60-72-month-old children's science process skills by the science education delivered to them through dramatic activities.

METHOD

Research Design

In the study, a quasi-experimental design with pre-test, post-test and retention test control group was used to determine the effect of the science process skills support program, which was prepared through dramatic activities for 60-72-month-old children, on children's science process skills.

Participants

The participants consisted of 36 60-72-month-old children who were attending kindergartens. Children attend public kindergartens in Kırıkkale province. After obtaining the necessary permissions for non-interventional research from the ethics committee in line with the Declaration of Helsinki, two groups of children with similar social, cultural and economic characteristics were selected. The criteria for the selection of the children were, being in the desired age group, not having a special needs report issued by the counceling and research center and volunteering to participate in the study. The experimental and control groups were determined by chance among the groups within the criteria determined by the systematic random sampling method. In order to prove that the experimental group and the control group had similar demographic characteristics, the distribution of demographic characteristics according to the groups was analyzed by using chi-square analysis, in Table 1. In the cases in which a significant relationship between variables was detected, the Phi coefficient (ϕ) was reported for variables with a degree of freedom of 1 to reveal the strength of the relationship, and in the cases in which the degree of freedom was greater than 1, the Cramer coefficient (V) was reported (Bursal, 2017). If the expected value was below five in less than 80% of the subgroups, the exact test was performed, and in the cases in which the degree of freedom was 1, the data were analyzed under appropriate conditions by paying attention to the continuity correction (Can, 2019).

Table 1. Analysis of Demographic Characteristics According to Participants

Group	Variable	Experimental		Control		ϕ	V	X^2	p
		n	%	n	%				
Sex	Girl	6	16.7	9	25.0	-0.17	-	.46	.49
	Boy	12	33.3	9	25.0				
Birth Order	First child	8	22.2	11	31.4	-	.18	1.17	.56
	Middle child	2	5.6	2	5.6				
	Last child	8	22.2	5	13.9				
Mother Education	Primary education	5	13.9	5	13.9	-	.21	1.65	.65
	High school	8	22.2	6	16.7				
	Undergraduate	3	8.3	6	16.7				
	Graduate	2	5.6	1	2.8				
Father Education	Primary education	4	11.1	2	5.6	-	.19	1.26	.74
	High school	6	16.7	8	22.2				
	Undergraduate	6	16.7	5	13.9				
	Graduate	2	5.6	3	8.3				
Number of siblings	Only child	5	13.9	5	13.9	-	.07	.19	.91
	Two siblings	9	25.0	10	27.8				
	Three or more siblings	4	11.1	3	8.3				

Income rate	Less than expense	7	19.4	7	19.4	-	.08	.21	.90
	Equivalent to expense	8	22.2	7	19.4				
	More than expense	3	8.3	4	11.1				
School attendance time	1 year and less	15	41.7	14	38.9	-	.17	1.42	.60
	1-2 years	3	8.3	3	8,3				
	More than 2 years	0	0	1	2,8				

It is observed that, the p value is greater than .05 in all of the chi-square significance values in Table 2. This means that, the children in the experimental group and the control group are similarly distributed.

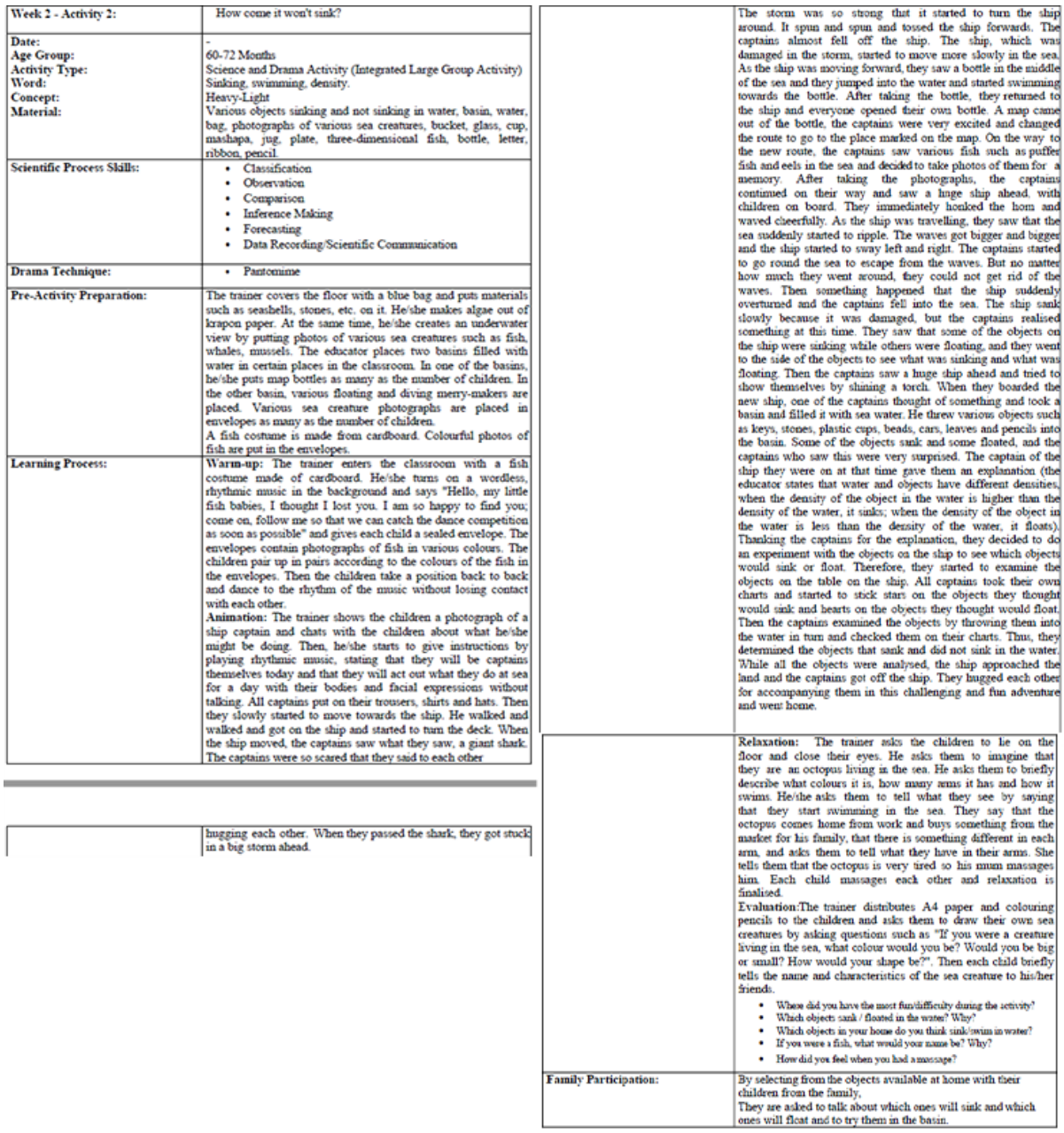
Data Collection

"General Information Form" and "Scientific Process Skills Test" were used to collect data in the study. The general information form includes questions about children's gender, birth order, duration of preschool attendance, parental education level, number of siblings, income status, etc.

The Scientific Process Skills Test (SPST) was developed to assess the scientific process skill levels of preschool students (Şahin, Yıldırım, Sürmeli, & Güven, 2018). The SPST consists of six sub-dimensions which are; observation, measurement, classification, prediction, inference and communication. The normative sample for the development of the SPST consisted of 212 60-72-months-old children, who were attending to four different kindergartens in İstanbul. The average duration required to complete the SPST is 10 minutes at most. The multiple-choice items had four options. The correct answers of the multiple-choice items got 1 (one) point while the items with incorrect or no answers got 0 (zero) points. In the scoring of open-ended items and performance questions, the correct answers got 1 (one) points while the incorrect answers got 0 (zero) points. Şahin et al. used the internal consistency analysis method to find the reliability of the SPST. Therefore, Kuder Richardson-20 (0.68) and Cronbach's alpha (0.68) reliability coefficients were used. As a result of the study, Cronbach's alpha was 0.683 and KR-20 was 0.683 (Şahin et al., 2018).

The difficulty and distinctiveness scores of the items were calculated by using item analysis. In the item analysis, children's test scores were sorted in descending order and scores were calculated by determining the upper and lower groups. Özdamar (2004) defines the range of $0.60 \leq \alpha < 0.80$ as "highly reliable" in the process of evaluating the alpha reliability coefficient (Özdamar, 2004; cited in Şahin et al. 2018). When the analysis results of the items were reviewed, the power of distinctiveness of the items are, 0.436, 0.327, 0.236, 0.309, 0.400, 0.218, 0.273, 0.327, 0.745, 0.727, 0.636, 0.345, 0.545, 0.400, 0.473, 0.582, respectively. Based on this data, only items 3, 6 and 7 were observed to have distinctiveness between 0.20-.29. These items were corrected following the analysis. The average difficulty of the 16 items was approximately 0.70 and the average distinctiveness was around 0.44.

Planned as 14 activities by the researchers, SEP-DA includes Classification, Observation, Comparison, Measurement, Prediction, Data Recording and Inference skills. These science process skills are presented to children through role playing, improvisation, creating plays from stories, and pantomime techniques in the program. Each drama activity consists of warm-up, role-playing, relaxation and evaluation stages. The draft training program created after planning was presented to field experts to receive their opinions and was finalized in line with the corrections received. The training program was examined in terms of drama techniques, suitability for children, and program structure and was deemed appropriate. The Activity Example is presented below.



Week 2 - Activity 2:	How come it won't sink?
Date: **Age Group:** **Activity Type:** **Word:** **Concept:** **Material:**	- 60-72 Months Science and Drama Activity (Integrated Large Group Activity) Sinking, swimming, density. Heavy-Light Various objects sinking and not sinking in water, basin, water, bag, photographs of various sea creatures, bucket, glass, cup, mashapa, jug, plate, three-dimensional fish, bottle, letter, ribbon, pencil.
Scientific Process Skills:	• Classification • Observation • Comparison • Inference Making • Forecasting • Data Recording/Scientific Communication
Drama Technique:	• Pantomime
Pre-Activity Preparation:	The trainer covers the floor with a blue bag and puts materials such as seashells, stones, etc. on it. He/she makes algae out of krapon paper. At the same time, he/she creates an underwater view by putting photos of various sea creatures such as fish, whales, mussels. The educator places two basins filled with water in certain places in the classroom. In one of the basins, he/she puts map bottles as many as the number of children. In the other basin, various floating and diving merry-makers are placed. Various sea creature photographs are placed in envelopes as many as the number of children. A fish costume is made from cardboard. Colourful photos of fish are put in the envelopes.
Learning Process:	**Warm-up:** The trainer enters the classroom with a fish costume made of cardboard. He/she turns on a wordless, rhythmic music in the background and says "Hello, my little fish babies, I thought I lost you. I am so happy to find you; come on, follow me so that we can catch the dance competition as soon as possible" and gives each child a sealed envelope. The envelopes contain photographs of fish in various colours. The children pair up in pairs according to the colours of the fish in the envelopes. Then the children take a position back to back and dance to the rhythm of the music without losing contact with each other. **Animation:** The trainer shows the children a photograph of a ship captain and chats with the children about what he/she might be doing. Then, he/she starts to give instructions by playing rhythmic music, stating that they will be captains themselves today and that they will act out what they do at sea for a day with their bodies and facial expressions without talking. All captains put on their trousers, shirts and hats. Then they slowly started to move towards the ship. He walked and walked and got on the ship and started to turn the deck. When the ship moved, the captains saw what they saw, a giant shark. The captains were so scared that they said to each other
	hugging each other. When they passed the shark, they got stuck in a big storm ahead.
	The storm was so strong that it started to turn the ship around. It spun and spun and tossed the ship forwards. The captains almost fell off the ship. The ship, which was damaged in the storm, started to move more slowly in the sea. As the ship was moving forward, they saw a bottle in the middle of the sea and they jumped into the water and started swimming towards the bottle. After taking the bottle, they returned to the ship and everyone opened their own bottle. A map came out of the bottle, the captains were very excited and changed the route to go to the place marked on the map. On the way to the new route, the captains saw various fish such as puffer fish and eels in the sea and decided to take photos of them for a memory. After taking the photographs, the captains continued on their way and saw a huge ship ahead, with children on board. They immediately honked the horn and waved cheerfully. As the ship was travelling, they saw that the sea suddenly started to ripple. The waves got bigger and bigger and the ship started to sway left and right. The captains started to go round the sea to escape from the waves. But no matter how much they went around, they could not get rid of the waves. Then something happened that the ship suddenly overturned and the captains fell into the sea. The ship sank slowly because it was damaged, but the captains realised something at this time. They saw that some of the objects on the ship were sinking while others were floating, and they went to the side of the objects to see what was sinking and what was floating. Then the captains saw a huge ship ahead and tried to show themselves by shining a torch. When they boarded the new ship, one of the captains thought of something and took a basin and filled it with sea water. He threw various objects such as keys, stones, plastic cups, beads, cars, leaves and pencils into the basin. Some of the objects sank and some floated, and the captains who saw this were very surprised. The captain of the ship they were on at that time gave them an explanation (the educator states that water and objects have different densities, when the density of the object in the water is higher than the density of the water, it sinks; when the density of the object in the water is less than the density of the water, it floats). Thanking the captains for the explanation, they decided to do an experiment with the objects on the ship to see which objects would sink or float. Therefore, they started to examine the objects on the table on the ship. All captains took their own charts and started to stick stars on the objects they thought would sink and hearts on the objects they thought would float. Then the captains examined the objects by throwing them into the water in turn and checked them on their charts. Thus, they determined the objects that sank and did not sink in the water. While all the objects were analysed, the ship approached the land and the captains got off the ship. They hugged each other for accompanying them in this challenging and fun adventure and went home.
	Relaxation: The trainer asks the children to lie on the floor and close their eyes. He asks them to imagine that they are an octopus living in the sea. He asks them to briefly describe what colours it is, how many arms it has and how it swims. He/she asks them to tell what they see by saying that they start swimming in the sea. They say that the octopus comes home from work and buys something from the market for his family, that there is something different in each arm, and asks them to tell what they have in their arms. She tells them that the octopus is very tired so his mum massages him. Each child massages each other and relaxation is finalised. **Evaluation:**The trainer distributes A4 paper and colouring pencils to the children and asks them to draw their own sea creatures by asking questions such as "If you were a creature living in the sea, what colour would you be? Would you be big or small? How would your shape be?". Then each child briefly tells the name and characteristics of the sea creature to his/her friends. • Where did you have the most fun/difficulty during the activity? • Which objects sank / floated in the water? Why? • Which objects in your home do you think sink/swim in water? • If you were a fish, what would your name be? Why? • How did you feel when you had a massage?
Family Participation:	By selecting from the objects available at home with their children from the family, They are asked to talk about which ones will sink and which ones will float and to try them in the basin.

Figure 1. *"How come it doesn't sink?" Example Activity Plan*

After obtaining the necessary permissions, the researcher conducted a preliminary study in the classrooms of these groups to facilitate the adaptation of the children. Pretests were first administered to the experimental and control groups. After the pretests, the science education program (SEP-DA) planned for 7 weeks was implemented with dramatic activities. While the experimental group participated in the education program, the control group continued with the existing curriculum. After the education program, post-tests were administered to both experimental and control groups. Three weeks after the post-test, only the experimental group was given a retention test.

Data Analysis

In order to decide on parametric/nonparametric tests with the data obtained in the study, it was checked whether the normality and homogeneity assumptions of the pre-test, post-test and retention test scores of the SPST sub-dimensions of the experimental group and the control group were met.

As a criterion for meeting the normality assumption, the coefficients of skewness and kurtosis were examined and observed to be within the range of ± 2. The values within this range in Table 2 were considered to meet the normality assumption (George and Mallery, 2016). The homogeneity assumption was tested by using Levene's test and the variances were checked for a significant difference.

Table 2. Normality Assumptions Related to the Measurement Scores

	Group	n	Z Score		Skewness		Kurtosis	
			Min.	Max.	Statistic	Std. error	Statistic	Std. error
Total pre-test	Experiment	20	-1.75	2.21	-.87	.54	1.02	1.03
	Control	20	-0.86	2.21	1.75	.54	1.5	1.03
Toplam post-test	Experiment	20	-0.81	1.82	-.08	.54	-.72	1.03
	Control	20	-1.69	1.52	.75	.54	.43	1.03
Total retention test	Experiment	20	-1.74	1.59	.17	.54	-.93	1.03

Independent samples t test analysis was used to show that the children had similar baseline levels and characteristics before starting the experimental process. A retention test was applied to determine the long-term results of the experimental effect. Repeated measures ANOVA analysis was used to reveal the effect at the end of the experimental process. The effect size of the results was examined through the eta square values. The effect size was based on the criteria (.01=small effect; .06=medium effect; .16=large effect).

FINDINGS

The analysis of the pre-test scores of the experimental group and the control group before the study is presented in Table 3.

Table 3. Comparison of Pretest Scores of Children in the Experimental and Control Groups

	Group	n	$\bar{x}$	t	df	$\acute{\eta}^2$	p
Total pre-test	Experimental	18	7.22	0.65	34	.01	.52
	Control	18	6.72				

When the pre-test scores were compared, the mean score of the experimental group was ($\bar{x} = 7.22$), and the mean score of the control group was ($\bar{x} = 6.72$). There was no significant difference between the initial scores of science process skills of the two groups [t(34)= 0.65 p=.52]. This indicates that, the two groups were selected at similar science process skill levels.

Table 4. Repeated Measures ANOVA Results of Children in Experimental and Control Groups

	Group	n	$\bar{X}$	sd		
Total pre-test	Experimental	18	7.22	2.73		
	Control	18	6.72	1.74		
	Total	36	6.97	2.27		
Total post-test	Experimental	18	11.72	2.67		
	Control	18	7.83	2.97		
	Total	36	9.78	3.41		
Source of Variance		SS	df	MS	F	p	ή2
Between group							
Group (E, C)		43.340	1	43.340	8.332	.007	.197
Error		176.847	34	5.201			
Within group							
Measurement (Posttest-Pretest)		141.681	1	141.681	49.590	.000	.593
Group*Measurement		51.681	1	51.681	18.089	.000	.347
Error		97.139	34	2.857			

According to Table 4, following the experimental procedure, there are significant differences between the pre-test and post-test scores of the children in the experimental group and the control group [F(1,34)=18.089, p<.001, $\acute{\eta}^2$=.347]. Considering the eta squared value, it is possible to say that, science education delivered through dramatic activities is highly effective on children's science process skills.

Figure 2 shows the significant difference between the score increase levels of the experimental group and the control group.

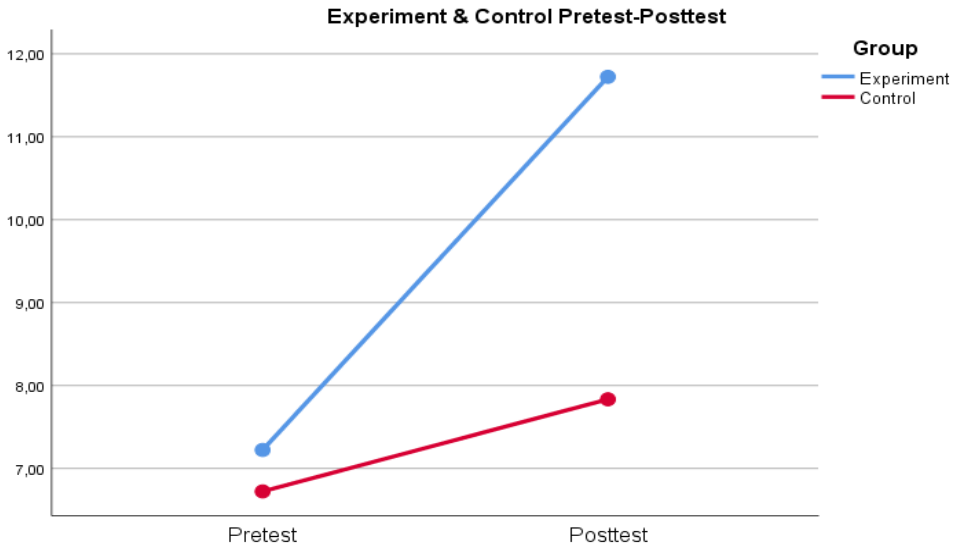


Figure 2. *Pre-test Post-test Comparison of the Children in the Experimental Group and the Control Group*

The analyses related to the comparison of the difference scores between the post-tests and pre-tests of the children in the experimental group and the control group are presented in Table 5.

Table 5. Comparison of Pre-test and Post-test Difference Scores of Children in the Experimental and Control Groups

(Posttest-Pretest)	Group	n	X̄	t	df	ή²	p
Total Difference	Experimental	18	4.50	4.25	34	.35	.000
	Control	18	1.11				

According to Table 5, the mean difference between the post-test and pre-test scores of the children in the experimental group was ($\bar{x} = 4.50$), while it was ($\bar{x} = 1.11$) for the control group was. The mean difference between the post-test and pre-test scores of the children in the experimental group differed significantly compared to the control group [t (34)=4.25, p<.001, $\acute{\eta}^2$=.35].

The results of the comparison of repeated measures in the experimental group and the control group are presented in Table 6.

Table 6. Repeated Measures ANOVA Results of Children in the Experimental Group

	Group	n	X̄	sd			
Total point	Pretest	18	7.22	2.73			
	Posttest	18	11.72	2.67			
	Retention	18	11.22	3.00			
Source of Variance	SS	df	MS	F	p	ή2	Diff.
Measurement	219.000	2	109.500	42.793	.000	.716	2>1 3>1
Error	87.000	34	2.559				
Total	306.000	36	112.059				

Table 6 demonstrates that the scores of science process skills of the children in the experimental group showed significant differences in the pre-test, post-test and retention tests [F (2,34)= 42.793, p<.001, $\acute{\eta}^2$=.716]. Comparison analysis revealed that, the scores of post-test ($\bar{x}$ =11.72) and retention ($\bar{x}$ =11.22) significantly increased compared to the scores of pre-test ($\bar{x}$ =7.22). This indicates that, there is a ongoing experimental effect.

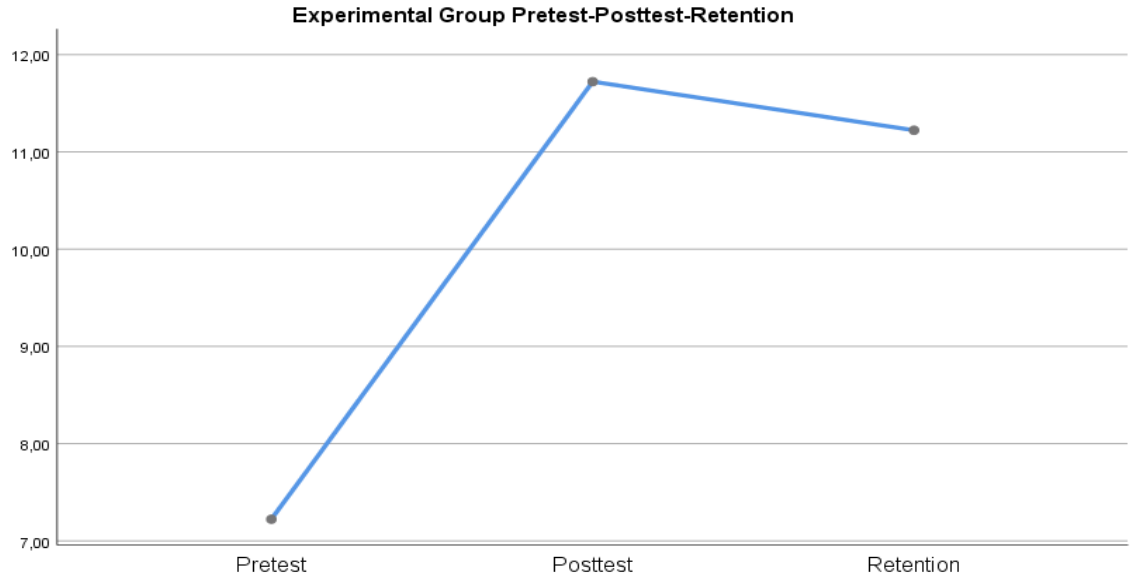


Figure 3. *Comparison of Pre-test, Post-test Retention of Children in the Experimental Group*

In Figure 3, the increase from the pre-test through the post-test is clearly visible. The fact that the decrease observed following the post-test is not significant can be considered as a reflection of the ongoing effect.

DISCUSSION & CONCLUSION

In this study, the fact that the initial levels and characteristics of the children in the experimental group and the control group were similar shows that there was no difference between the pre-test scores of the experimental group and the control group. At the end of the experimental process, the difference between the science process skill scores of the children in the experimental group and the science process skill scores of the children in the control group increased. It was revealed that science education through dramatic activities had a strong effect on the science process skills of the children in the experimental group and this effect was long-term as a result of the retention test. The effect of science education on scientific process skills was also clearly proved in the preschool period. The use of drama, one of the creative methods, in the delivery of science education both facilitated the concretization for preschool children and enabled them to be directly involved in the process as active participants. Due to the relationship between creativity and scientific process skills, it is possible to say that, drama has a direct effect on thinking skills. It is known that, especially in early years, there is a significant relationship between creative learning and scientific process skills (Bahakti and Astuti, 2018). In a study conducted by Yıldız and Yıldız (2021) with 70 60-66-month-old children, a moderate significant relationship was found between children's creative thinking and science process skills. Yalçın and Erden (2021) concluded that, STEM activities increase creativity and problem solving skills. In a similar study, Dhir (2014) found a positive relationship between creativity and science process skills. Although mostly the effect of science activities on creativity is observed in the literature, there are also studies which demonstrate that creative activities improve science process skills (Astutik et al., 2019; Stephenson, 2023). Compared to traditional methods, the use of innovative and imaginative methods in preschool has an important role in the development of the scientific process (Bagherpour and Shamshiri, 2018; Yıldız and Yıldız, 2021). Considering that, scientific process skills are included in the preschool education, this study similarly reveals that, the drama method is greatly effective compared to the traditional method (MEB, 2013). Karakelle (2009) focused on the effect of creative drama process on thinking skills in an experimental group of 30 adults. As a result of the research, he determined that, creative drama was effective in improving the fluency and flexibility of thinking. Using the Collaborative Creative Learning (CCL) method, Astutik et al. (2019) worked with 144 secondary school students in an experimental design. As a result of the study, it was proved that, it affects science process skills while learning physics. Tekerci and Kandır (2017) found that, the sensory-based science education program they carried out with 60-66-month-old children made a difference as a result of the experimental effect. Similarly, this study proved that, including creative methods in science education improves science process skills of preschool children. In addition to that, the fact that the role-playing method included in the dramatic activities used in the study is a combinational skill based on functionality, communication and thinking, increases the effectiveness in the acquisition of scientific process skills (Vyas et al.,

2013). While this study contributes theoretically and practically to the relationship between creativity and science process skills, it also maintains its originality as it is one of the few studies that reveal this effect in preschool period through experimental methods. Teaching the skills that are necessary but difficult to comprehend such as science education through creative ways such as drama, not only improves the science process skills but also increases the retention of science education. The limitations of the study such as the fact that it was conducted in a semi-experimental design and with a limited sample and that it was not compared with other alternative methods should be taken into consideration. However, considering the limitations of this study, it is expected that, a similar study in a full experimental design will be produced more explicitly by delivering science education in different ways.

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Statements of Publication Ethics

All processes in this study comply with the organization's code of ethics, the 1964 Helsinki Declaration and its subsequent amendments.

This study was conducted with the approval of Kırıkkale University Non-Interventional Research Ethics Committee. Ethics committee approval was obtained from the Ethics Committee with the decision dated 12.01.2022 and numbered 2022.01.21. Consent forms were obtained from all teachers and parents of the children included in the study.

Researchers' Contribution Rate

Authors	Literature review	Method	Data Collection	Data Analysis	Results	Conclusion
Gamze İncesu	☒	☒	☒	☐	☒	☒
Mehmet Güney	☒	☒	☐	☒	☒	☒
Aygen Çakmak	☒	☐	☐	☐	☐	☒

Conflict of Interest

The authors declare that they have no relevant or material financial interests that relate to the research described in this paper.

REFERENCES

Adıyaman, A. K. (2019). *Teaching the Science and the Nature of Scientific Knowledge to the 7th Grade Students with Drama Method* (Master's Thesis). Trakya University Institute of Science and Technology, Edirne.

Akar Gençer, A. & Akman, B. (2016). Assessing the effect of drama method upon the formation of children's idea about scientists and their inventions. *Elementary Education Online*, 15 (1), 0-0. https://doi.org/10.17051/io.2016.66263

Aksan, Z. & Çelikler, D. (2016). Preparing activities for teaching science subjects to pre-school children through dramatization method. *Mustafa Kemal University Journal of Graduate School of Social Sciences*, 13 (35), 108-122.

Aktaş Arnas, Y. (2002). The aims of science education in preschool period. *Journal of Child Development and Education*, 1 (6-7), 1-6.

Akyol, N. & Birinci Konur, K. (2018). The examination of preschool teachers' and school managers' views on the applicability of pre-school science education. *Kastamonu Education Journal*, 26 (2), 547-557. https://doi.org/10.24106/kefdergi.389823

Altıntaş, E. & Kaya, H. (2012). Self-qualification and attitudes towards processing of science and technology course by drama method of the prospective science teachers. *Erciyes University Graduate School of Science Journal of Science*, 28 (4) , 287-295.

Astutik, S., Mahdiannur, M. A., Suliyanah, L., & Prahani, B. K. (2019). Improving science process skills of junior high school students through the implementation of collaborative creativity learning (CCL) model in physics learning. *Journal of Physics Conference Series*, 1171, 1–6. https://doi.org/10.1088/1742-6596/1171/1/012006

Ayvacı, H. K. & Yurt, Ö. (2016). Children and science education. *Child and Civilisation*, 1 (1), 15-28.

Ayvacı, H. Ş., Atik, A. & Ürey, M. (2006). The perceptions of preschool children on the concept of scientist. *Bartin University Journal of Faculty of Education*, 5 (3), 669-689. https://doi.org/10.14686/buefad.v5i3.5000193186

Bagherpour, M., & Shamshiri, B. (2018). The effect of educational methods on creativity of pre-school children: A case study. *Management Science Letters*, 8(6), 717–724. https://doi.org/10.5267/j.msl.2018.5.006

Bakkaloğlu, N. (2017). *The effect of using creative drama as a method in primary school environment subjects on students' achievement, retention and attitudes* (Doctoral Thesis). Hacettepe University Institute of Educational Sciences.

Barakat, A. (2023). The effects of digital drama-based instruction on developing receptive and expressive language among kindergarten children. *International Journal of Instruction*, 16(1), 103-118. https://doi.org/10.29333/iji.2023.1616a

Başkan Takaoğlu, Z. & Demir, V. (2018). Evaluation of science activities used in preschool education. *Mediterranean Journal of Educational Research*, 12 (25), 76-101. https://doi.org/10.29329/mjer.2018.153.5

Behram, M. (2019). *Investigation of the effect of STEM education on scientific process skills of preschool students* (Master's Thesis). Istanbul Aydın University, Institute of Social Sciences.

Bhakti, Y. B., & Astuti, I. A. D. (2018). The influence process of science skill and motivation learning with creativity learn. *Journal of Education and Learning (EduLearn)*, 12(1), 30-35. https://doi.org/10.11591/edulearn.v12i1.6912

Bilgiş, S. (2019). *Investigation of primary school science activities with children's pictures* (Master's Thesis). Istanbul Aydın University Institute of Social Sciences.

Bingöl, D. & Ünal, M. (2019). The Investigation of MONE Pre-school Science Activities According to the Scientific Processing Skills. *Erzincan University Journal of Faculty of Education*, 21 (2), 158-177. https://doi.org/10.17556/erziefd.458548

Bulut Üner, A. N. (2018). *Pre-school teacher candidates' scientific process skills affect self-efficacy beliefs toward attitudes and teaching towards science and mathematics* (Master Thesis). Dokuz Eylül University Institute of Educational Sciences, İzmir.

Bursal, M. (2017). *Basic data analyses with SPSS*. ANI Publishing. ISBN: 978-605-170-310-7

Büyüktaşkapu, S. (2010). *A Science Teaching Program Proposal based on Constructivist Science Education to develop 6 year-old Children's Scientific Processing Skills* (Doctoral Thesis). Selçuk University Institute of Social Sciences, Konya.

Can, A. (2019). *Quantitative data analysis in scientific research process with SPSS*. Pegem. ISBN:9786053644484

Can, S. & Yıldırım, M. (2017). "Deal or no deal": should science lesson be taught with instructional games? *Journal of Atatürk University Kazım Karabekir Faculty of Education*, (35), 14-30.

Can Yaşar, M. (2009). *Investigation of the effect of drama education on the creative thinking skills of six-year-old children attending kindergarten* (Doctoral Thesis). Ankara University Institute of Science and Technology, Ankara.

Delihasanoğlu, M. (2021). *Investigation of preschool teachers' attitudes towards creative drama and self-efficacy towards using creative drama method* (Master's Thesis). Bolu Bant İzzet Baysal University Institute of Postgraduate Education, Bolu.

Dhir, T. (2014). Problem solving ability and science process skills as the influential factors of scientific creativity. *International Journal of Research Pedagogy and Technology in Education Movement Sciences*, 2(4), 11–17. ISSN: 2319-3050

George, D., & Mallery, P. (2016). *Frequencies in IBM spss statistics 23 step by step*. Routledge. https://doi.org/10.4324/9781315545899

Gezgin, D. & Kılıç, D. (2015). Determination of Pre-school Teachers' Preferred Acquisitions and Methods for Science Activities. *Mersin University Journal of the Faculty of Education*, 11 (3), 620-630. https://doi.org/10.17860/efd.46048

Güngör Seyhan, H. (2015). The importance of using analogy in preschool science education and examples of analogy. *Cumhuriyet International Journal of Education*, 4 (2), 15 – 28. https://doi.org/10.30703/cije.321366

Harlen, W. (2013). *Assessment & inquiry-based science education.* Triestly Italy: Global Network of Science Academies (IAP) Science Education Program (SEP). ISBN: 978-1-291-33214-8

Horikami, A., & Takahashi, K. (2022). The tripartite thinking model of creativity. *Thinking Skills and Creativity*, 44, 101026. https://doi.org/10.1016/j.tsc.2022.101026

Kale, S. (2019). *Investigation of the effect of STEM applications on pre-school teachers' scientific process skills* (Master's Thesis). Manisa Celal Bayar University Institute of Science and Technology, Manisa.

Karakelle, S. (2009). Enhancing fluent and flexible thinking through the creative drama process. *Thinking Skills and Creativity*, 4(2), 124-129. https://doi.org/10.1016/j.tsc.2009.05.002

Karakuş, H. (2021). Parents' views on science education in preschool. *Trakya Journal of Education*, 11 (3), 1431-1443. https://doi.org/10.24315/tred.852592

Karaman Eflatun, H. (2021). *Preschool teachers' attitudes towards science teaching and their opinions on science and nature activities* (Master's Thesis). Fırat University Institute of Educational Sciences, Elazığ.

Kara, Y. & Aslan, B. (2018). A Research on Determining the Effect of Drama Based Science Activities on Social Skills in the Teaching of Nutrients Issue. *Yüzüncü Yıl University Journal of Faculty of Education*, 15 (1), 698-722. http://dx.doi.org/10.23891/efdyyu.2018.84

Kasbary, N. (2024). Drama in steam education: possible approaches and connections to drama-based activities in steam education. *The Hungarian Educational Research Journal*. https://doi.org/10.1556/063.2024.00272

Kefi, S. (2014). *The effect of supportive science activities programme training on the levels of using basic science process skills of preschool teachers* (Doctoral Thesis). Selçuk University Institute of Social Sciences, Konya.

Kefi, S. (2018). Scale for Level of Using Basic Scientific Process Skills: Validity and Reliability of Parent Form. *Kastamonu Education Journal*, 26 (3), 613-628). https://doi.org/10.24106/kefdergi.379210

Köse, A. (2018). *A creative drama-based syllabus proposal for the development of speaking skills at the second level of primary education* (Master's Thesis). Gazi University Institute of Educational Sciences, Ankara.

Kula, G. (2011). *The effect of pre-school education on 9th, 10th and 11th grade students' scientific process skills: Polatlı district example* (Master's Thesis). Gazi University Institute of Educational Sciences, Ankara.

Kunt, B. (2016). *Determination of science process skills of 60-72 months preschool students* (Master's Thesis). Dumlupınar University Institute of Educational Sciences, Kütahya.

Lutfiani, N., Khoirunisa, A., Faturahman, A., & Nabila, E. (2021). Science literacy in early childhood: development of learning programs in the classroom. *Aptisi Transactions on Technopreneurship* (Att), 3(2), 31-36. https://doi.org/10.34306/att.v3i2.187

MEB (2013). *Child development and education science and nature activities*. Ankara. http://www.megep.meb.gov.tr/mte_program_modul/moduller/Fen%20ve%20Matematik%20Etkinlikleri.pdf

MEB (2013). *Preschool education programme*. Ankara. https://tegm.meb.gov.tr/dosya/okuloncesi/ooproram.pdf

Mutlu, S. (2012). *The effects of science and technology education focused on scientific process skills on science process skills, motivation, attitude and achievement of primary school* (Master's Thesis). Trakya University Institute of Science and Technology, Edirne.

Nuhoğlu, H. & Ceylan, R. (2012). Evaluation of objectives and achievements in pre-school curriculum interms of scientific process skills. *Journal of Buca Faculty of Education*, (34), 112-127.

Ölçer, S. & Aşıkoğlu Özdemir, D. (2018). A comparative study creativity levels of pre-school teachers and science learning of 60-72 months childrens. *Journal of Awaraness*, 3 (5), 837-856. https://doi.org/10.26809/joa.2018548696

Özbey, S. & Alisinanoğlu, F. (2010). Testing validity and reliability of "the preschool teachers' competencies in science activities scale". *Journal of National Education*, 40 (185), 266-277.

Özkan, B. (2015). *Development of scientific process skills scale for 60-72 months old children and the effect of science programme based on brain-based learning on scientific process skills* (Doctoral Thesis). Marmara University Institute of Educational Sciences Department of Primary Education Division of Preschool Teaching, İstanbul.

Özoğlu, M. Z. (2020). *Investigation of the relationship between preschool teachers' competences related to science activities and basic science process skills of 60-72 months children* (Master's Thesis). Okan University Institute of Health Sciences, İstanbul.

Özpir Mantaş, H. C. (2018). *Preschool science education: A content analysis* (Master's Thesis). Yıldız Technical University Institute of Science and Technology, İstanbul.

Öztürk, M. (2016). *The effect of inquiry-based science education programme on 60-72-month-old children's science process skills and language and concept development* (Doctoral Thesis). Hacettepe University Institute of Educational Sciences, Ankara.

Saygılı, P. & Ercan Yalman, F. (2021). Investigation of the effect of game-based learning method on scientific process skills in preschool. *Journal of National Education*, 50 (231), 7-26. https://doi.org/10.37669/milliegitim.755100

Sriwarthini, N., Astini, B., & Gunawan, G. (2023). Analysis of early childhood pre-service teacher's science concepts comprehension based on their science process skill. *Jurnal Penelitian Pendidikan Ipa*, 9(2), 906-911. https://doi.org/10.29303/jppipa.v9i2.3241

Stephenson, L. (2023). Collective creativity and wellbeing dispositions: Children's perceptions of learning through drama. *Thinking Skills and Creativity*, 47, 101188. https://doi.org/10.1016/j.tsc.2022.101188

Şahin, Ç., Uludağ, G., Gedikli, E., & Karakaya, L. (2018). Developing of The Scale on Determining Parents' Views About Science and Preschool Science Activities. *Kastamonu Education Journal*, 26(1), 101-108. https://doi.org/10.24106/kefdergi.375673

Şahin, F., Yıldırım, M., Sürmeli, H., & Güven, İ. (2018). A test development study for evaluation of preschool children's scientific process skills. Science, Education, *Art and Technology Journal (SEAT Journal)*, 2(2), 124-138.

Tan, M. & Temiz, B. K. (2003). The importance and role of the science process skills in science teaching. *Pamukkale University Journal of Faculty of Education*, 13 (13), 89-101.

Tekerci, H., & Kandır, A. (2017). Effects of the sense-based science education program on scientific process skills of children aged 60–66 months. *Eurasian Journal of Educational Research*, 17(68), 239-254. http://dx.doi.org/10.14689/ejer.2017.68.13

Trundle, K.C.& Saçkes, M. (2015). *Research in early childhood education*. Newyork:Springer. ISBN: 978-94-017-9504-3, ISBN: 978-94-017-9505-0(eBook), https://doi.org/10.1007/978-94-017-9505-0

Ünal, M. & Akman, B. (2006). Early childhood teachers' attitudes towards science education. *Hacettepe University Journal of Faculty of Education*, 30 (30), 251-257.

Vyas, D., van der Veer, G., & Nijholt, A. (2013). Creative practices in the design studio culture: Collaboration and communication. *Cognition, Technology & Work*, 15(4), 415–443. https://doi.org/10.1007/s10111-012-0232-9

Yalçın, V., & Erden, Ş. (2021). The effect of STEM activities prepared according to the design thinking model on preschool children's creativity and problem-solving skills. *Thinking Skills and Creativity*, 41, https://doi.org/100864. 10.1016/j.tsc.2021.100864

Yaz, Ş. (2018). *The effect of designed laboratory activities on science process skills perceptions and attitudes of science teacher candidates* (Master's Thesis). Kastamonu University Institute of Science and Technology, Kastamonu.

Yıldırım, E. (2021). *A meta research on the effectiveness of drama method in basic education level* (Doctoral Thesis). Istanbul University-Cerrahpaşa Institute of Postgraduate Education, İstanbul.

Yildiz, C., & Yildiz, T. G. (2021). Exploring the relationship between creative thinking and scientific process skills of preschool children. *Thinking Skills and Creativity*, 39, 100795. https://doi.org/10.1016/j.tsc.2021.100795

Yılmaz, G. (2017). *The effect of family participation science activities on science process skills and attitudes towards science of 5-6 year old children* (Master's Thesis). Uludağ University Institute of Educational Sciences, Bursa.