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The effect of STEM training practices developed for children on scientific process skills*

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Abstract

This study was conducted to examine the effect of STEM education training practices developed for preschool children by the researcher on scientific process skills. The research is in the form of a quasi-experimental study. The research group consists of preschool children studying in the preschool classrooms of a primary school in 2020-2021. In the research, the "Preschool Scientific Process Skill Test " developed by Sahin, Yıldırım, Sürmeli, and Güven (2018) and the "General Information Form" developed by the researcher were used as data collection tools. At the beginning of the research, a pre-test was applied to each participant after obtaining the necessary permissions. STEM education training activities developed by the researcher were applied to the children in the experimental group during the research process; the daily education flow specified in the 2013 Preschool Education Program continued for the children in the control group. Independent groups T-Test was performed to reveal the difference between pre-test and post-test scores; paired sample T-Test was conducted to see if there was a significant difference between pre-test and post-test scores of experimental and control groups. T-Test and one-way analysis of variance (ANOVA) was used to see the effect of demographics on scientific process skills. According to the results of the analyses, no significant difference was found between pre-test scores; however, a significant difference was observed between post-test scores in favor of the experimental group. It was concluded that the developed STEM training practices positively affect the children's scientific process skills.

Keywords:

Early childhood, STEM, scientific process skills, preschool.

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INTRODUCTION

Human beings are creatures who have always kept their curiosity fresh from the past to the present. Fast access to information has especially become easier in the 21st century with the developments in technology. These rapid developments have led to the emergence of new systems in many areas. Hence, today's people have become more productive, and at the same time, they question the knowledge they access rather than accepting it dogmatically (Akgündüz, Aydeniz, Çakmakçı, Çavaş, Çorlu, Öner & Özdemir, 2015). Critical thinking, problem solving, information literacy, and learning to learn are examples of these skills that enable people to closely follow their period's developments (Binkley, Erstad, Herman, Razen, Ripley, Miller-Rici & Rumble, 2012).

Along with developing skills, countries have made the necessary arrangements to not lag behind the times; they took important steps toward catching up with the era with these regulations. In this sense, important steps have been taken in Turkey with the 2023 Education Vision; the importance of raising individuals who are well-equipped, curious about science, and keeping up with the times was emphasized. The importance of early childhood, which is accepted as the first years of life, was also mentioned in the relevant vision, and the necessity of increasing the investments for early childhood and including preschool education within the scope of compulsory education was underlined (Ministry of National Education [MONE], 2018).

According to the literature, early childhood is very important for the future of individuals; it is a period in which curiosity, questioning, logical and mathematical mastery, and sensitivity to science increase proportionally (Ekici, Bardak & Zadeh, 2018; Erdoğan & Baran, 2005; Kıldan & Pektaş, 2009). The plans and teaching processes that will positively affect children's development should be included in this period which seriously affects children's future. Children's curiosity and interest in science should be promoted. Children should be allowed to learn on their and should be guided where necessary. In this sense, it should not be forgotten that early childhood is the basic building block of life. The developmental characteristics of children should be taken into account while providing education.

The development of children accelerates in the preschool period, and children gain experience in producing solutions to the problems they encounter (cited in Anlıak & Dinçer, 2005). The preschool period, known as the first period in the child's life, covers critical times. The skills that the child should acquire in this period should be presented with rich stimuli. The knowledge and skills that the child cannot acquire in time will appear in the future as problems that are difficult to solve (Gürkan, 2000). For this reason, the scientific skills that the children would acquire in the preschool period are very important, as these skills will positively affect the reasoning ability the children will use in the future. Considering all these facts, the policies implemented in the education systems by the states, the value they attach to the children and the investments made in the preschool area gain importance.

In today's world, many countries aim to raise productive individuals who are equipped with today's century skills and who contribute to all developments. With the acceleration of 21st century needs and technological development, the need for individuals who can research, explore, and analyze is increasing day by day (Bal, 2018). Considering these needs, STEM training activities that will keep children's interest in science alive and serve many aspects of science have come to the fore and have begun to take their place in the education programs of many countries (STEM Education Report, 2016).

STEM education, whose goal is to raise 21st-century people, is an initiative that includes different components (DeJarnette, 2012). STEM education, which was first put into practice in the United States, spread to many countries globally over time and it aimed to raise individuals to fit the age of science by

integrating STEM into the countries' education systems. When the intended goals are successful, individuals reach the level where they can use scientific process skills actively.
STEM activities, which are important in developing children's scientific thinking, producing rational solutions to problems, and improving reasoning skills, are also important in developing scientific process skills. Since STEM education is an investment made in early childhood that supports children's scientific process skills, it also strengthens countries' economic and social structures (Gonzalez & Kuanzi, 2012; Kandemir & Yılmaz 2012).

International and domestic studies involving STEM training activities conducted in the recent past, where STEM training activities have gained such importance, are very limited; besides, many studies that contribute to the literature mostly cover other periods apart from early childhood (Akdağ & Güneş, 2015; Altan & Üçüncüoğlu, 2018; Aygen, 2018; Gökbayrak & Karışan, 2017; Moore, Stohlmann, Wang, Tank, Glancy & Roehrig, 2014; Özbilen, 2018; Roehrig, Moore, Wang & Park, 2012; Swaid, 2015; Yıldırım & Altun, 2015; Yıldırım & Selvi, 2017; Yılmaz, Gülgün & Çağlar, 2017). There are many notable studies on children's scientific process skills in the preschool period (Alabay, 2013; Ayvacı, 2010; Büyüktaşkapu, Çeliköz & Akman, 2012; Karamustafaoğlu & Kandaz, 2006; Kuru & Akman, 2017; Şahin, Güven & Yurdatapan, 2011; Şahin, Yıldırım, Sürmeli and Güven, 2018; Tan &Temiz, 2003; Vurucu, 2019). In addition, Kazakoff, Sullivan and Bers (2013) work in STEM magnet schools, Bagiati and Evangelou (2015) engineering-based STEM studies, Aquilar (2016) and Donnelley Smith (2018) has worked with teachers on STEM. Besides, Durkin (2018) working with children on STEM-based weather conditions, Park, Park and Bates (2018); Case study STEM activities with children aged 3-6 Floreal (2019) and Tao (2019) are schools for STEM-based applications. By carrying out studies on the attitudes of administrators and teachers, different have made gains.

STEM activities applied in early childhood are an important area in children's development (Ekici et al., 2018). Different methods have been used for children's scientific process skills. However, STEM training activities in the preschool period have started to occupy a very important place recently, especially in children's scientific process skills. There are some studies in the literature involving the effect of STEM activities on the scientific process skills of children in the preschool period, but these studies are limited (Akçay, 2018; Akçay, 2019; Alan, 2020; Ata-Aktürk, 2019; Bal, 2018; Çilengir-Gültekin, 2019; Öcal, 2018; Ünal, 2019). In this sense, there is emptiness in the relevant literature. This study will fill the gap by examining the effect of STEM activities on children's scientific process skills. This study is thought to be important in shedding light on future studies. Based on all this information, in this study, STEM education training activities were prepared for children in early childhood to develop and support children's scientific process skills. The study aims to investigate the effect of STEM education training activities on children's scientific process skills. Pre-School Scientific Process Skill Test (SPST) developed by Şahin, Sürmeli, Yıldırım, and Güven (2018) was selected to measure the effect of STEM education training activities on children's scientific process skills, and necessary permissions were obtained from the relevant people.

METHOD

The main purpose of this study is to examine the effect of STEM education training activities developed for preschool children on children's scientific process skills. For this purpose, the following research question was addressed: what is the effect of STEM education training activities prepared for children in early childhood on their scientific process skills?

Research Design

In this study, a quasi-experimental method consisting of pre-test/post-test, with control and experimental groups, was used. In this design, the participants are not randomly assigned to the groups; they are already ready (Büyüköztürk, Çakmak, Akgün, Karadeniz & Demirel, 2010). The test is applied to participants both at the beginning and at the end of the study. It is an excellent method to see the effects of the dependent variable on the independent variables (Fraenkel, Wallen & Hyun, 2011). In experimental studies, research-oriented training activities are performed in the experimental group, whereas no intervention is made in the control group (Creswell, 2017).

Participants and Procedure

The research group consisted of young children who attend preschool classrooms of a primary school affiliated with MONE in a province in the fall semester of the 2020-2021 academic years. A total of 20 children, 10 in the experimental and 10 in the control group were included in the study. Since the implementation process of the study took place during the pandemic, more children could not be included in the study. Before starting the study, necessary permissions were obtained from the parents, relevant institutions, and persons. During the study, social distance rules were followed, and maximum attention was paid to masks and hygiene rules.

The experimental and control groups selected as the research sample were determined by simple random sampling, where everyone has an equal chance to be included in the experimental and control groups (Büyüköztürk et al., 2018).

Measures

SPST developed by Şahin, Yıldırım, Sürmeli and Güven (2018) was used as a data collection tool. In addition, the General Information Form was used to collect information about the families of the children included in the study. The researcher obtained the necessary permissions from families using the Parent Permission Certificate prepared by the researcher for the scale applied to the children in the experimental group and the STEM education training activities developed by the researcher. Likewise, for the scale applied to the children in the control group, the necessary permissions were taken from the families by using the Parent Permission Certificate.

General Information Form

The General Information Form was created to determine the demographic characteristics of the children participating in the study and their families. This form contains information such as children's full name, number of siblings, gender, date of birth, mother's education, mother's occupation, father's education, father's occupation, family income, and whether the family is an immigrant.

Preschool Scientific Process Skill Test (SPST)

SPST developed by Şahin, Yıldırım, Sürmeli & Güven (2018) was used to determine the scientific process skills of preschool children. The test contains a total of 16 questions covering the scientific process skill levels of preschool children (observation, classification, estimation, measurement, recording data, communication, and reasoning). The content of the questions was prepared in a way that children could understand, and the developmental characteristics and periods of children were taken into consideration. There are 12 multiple choice questions, three open-ended questions, and one performance-based question in the test. The average administration time is 15 minutes.

The research aimed to implement STEM education training activities to support and develop children's scientific process skills and measure children's scientific process skills. It was planned to use the control and experimental group model with a pre-test-post-test before and after implementing STEM education training activities (Karasar, 2005). Expert opinions were consulted to confirm the suitability of the test, and SPST was found to be suitable for use in the study. The features of the SPST are given below (Şahin, Yıldırım, Sürmeli & Güven, 2018).

STEM Education Training Practices

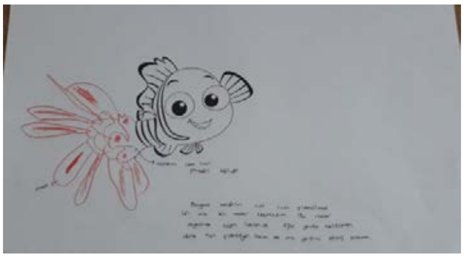
A detailed field search was conducted for STEM education training activities (12 activities with STEM content), which were developed to improve the scientific process skills of children in early childhood. In line with the results obtained from the field search, 12 STEM-related activities were prepared for preschool children, and a six-week implementation process was carried out. The opinions of three experts in early childhood were taken, and 12 activities with STEM content prepared by the researcher have been revised accordingly. In addition, the opinions and suggestions of six preschool teachers working in the field were taken into consideration. The activities were prepared to include STEM components, namely science, technology, engineering, and mathematics. The prepared STEM education application addressed the developmental characteristics of children and various development areas (cognitive, affective, psychomotor, etc.). The activities were prepared in line with the achievements and indicators of the MONE 2013 Preschool Education Program. The process supported the development of children in terms of creativity and imagination besides scientific process skills, and attention was paid to opportunity education. The activities were planned based on the Basic Features of the Program in the MoNE 2013 Pre-School Education Program, including the following characteristics: "child-centered," "flexible," "balanced," "exploratory learning is a priority," "promoting the development of creativity," and "themes are a tool, not a goal."

STEM education training activities, developed according to the program's basic features, were integrated with art, music, movement activities, and the preparation to read and write. All development areas of children (cognitive development, language development, social and emotional development, motor development, and self-care skills) were included. Each activity consisted of the following titles: name of the activity, type, age group, achievements and indicators, materials, words, concepts, learning process, evaluation, and adaptation. Opinions were received from two educators, each being an expert in science and mathematics, on the suitability of STEM-based activities prepared in the program's content to science, mathematics, engineering, and technology. In addition, the opinions of an educator who is an expert in the field of information technologies and robotic coding were taken, and the researcher gave the activities the final form after getting all opinions and suggestions. The overall table of the training activities consisting of prepared STEM-based activities is as follows:

Table 1.STEM Education Training Activities Schedule

Week	Theme of the Activity	Name of the Activity
1. Week	Fish Theme	Do Fish Drink Milk? Lost Fin of the Clownfish
2. Week	Train Theme	Black Train My Train Station!
3. Week	Ant Theme	The Life Adventures of Ants Imagine & Design
4. Week	Computer Theme	Are Computers Intelligent? Young Inventors Design Computers
5. Week	Kangaroo and Bridge Theme	Let's Know the Kangaroo We Design a Bridge
6. Week	Robot Theme	The Origin of Robots I am Designing a Robot

For example; In the "Lost Fin of the Clownfish" activity, which was prepared around the ***fish theme***, how a fin can be designed for a clown fish that lost one of its fins, and how the designed fin could facilitate the movement of the fish in the water was discussed and brainstormed before the activity. Children were given the opportunity to guess, communicate by explaining the designs they guessed and visualize the results of their designs by drawing.

Schema 1. Drawings of lost fin of the clownfish activity

Administration of the Pre-test

SPST was administered as the pre-test to the preschool children included in the experimental and control groups. The pre-test was carried out in an empty classroom on the floor where the kindergartens are located. The researcher administered the pre-test, and the answers given by the children were noted one by one. SPST was administered to each child individually, and the pre-test application took approximately 15-20 minutes for each child.

Implementation of Developed STEM Education Training Activities

STEM education training activities developed by the researcher within the scope of the study were administered to the experimental groups for six weeks, as two days a week. The implementation started on the first school day of the week following the end of the pre-test. Since the implementation days did not fall on any public holiday, no problems were encountered. Before implementing the activities, the researcher organized a meeting with the children in the experimental group. Both the researcher and the training activities were introduced to the children. The children in the control group continued the activities included in the daily education flow and the practices included in the monthly plan of the school while the activities were being applied to the experimental group. The education process continued with the preschool teacher for the control group, and the researcher did not intervene. The beginning stages were started with science and mathematics activities rather than engineering and design activities through the themes distributed across weeks. In this way, important schemes, namely recognizing the problem, producing possible solutions based on the problem, designing, and making decisions, were created in the mind of experimental group children (Hynes, Portsmore, Dare, Milto, Rogers, Hammer & Carberry, 2011). Implementing engineering and design skills activities continued based on the schemes formed in the children's minds. Before each activity, the past activities were reminded, and the children were talked about what they remember. The activity process continued with a spiral approach every week. Three-dimensional evaluation (from the child's perspective, the researcher's perspective, and the program's perspective) was made after each activity for a total of 12 activities implemented throughout the process.

Administration of the Post-Test

After performing the developed STEM education training activities to the experimental group, the post-test (SPST) was conducted on the children in the experimental and control groups. The administration of the post-test was carried out in the same environment as the pre-test. The post-test study was applied individually to each child in the experimental and control groups. Meanwhile, the researcher observed that the application with the children in the experimental group took shorter.

Data Analysis

The information collected with the General Information Form and SPST were transferred to the computer environment and analyzed with the SPSS program. In the data analysis part, since the total number of participants in the experimental and control groups was less than 30, the literature review showed non-parametric tests are performed in these cases (Fraenkel et al., 2011). However, having less than 30 participants in the experimental and control groups was not always sufficient as the only criterion

(Büyüköztürk et al., 2010). Therefore, the normality of the data obtained from the groups was checked. Parametric test conditions of the data distribution should be checked to make scientifically accurate predictions about the study population. For this purpose, the Kolmogorov-Smirnov test was applied to examine the kurtosis and skewness coefficients and decide whether the data showed normal distribution.

According to the relevant test results, the pre-test data showed a normal distribution, and the post-tests showed a near-normal distribution (Chou & Bentler, 1995). In line with the results obtained by taking the opinions of three statistics experts, analyses were performed by using parametric tests in the research, and the results were interpreted.
The parametric tests used in the analyses and the groups for which they were used are as follows:

- → Independent Groups T-Test was used to see whether there was a significant difference between the pre-test scores of the experimental and control groups.
- → Independent Groups T-Test was used to see whether there was a significant difference between the post-test scores of the experimental group and the control group, which was not intervened.
- → Paired Sample T-Test was conducted to determine whether there was a significant difference between the experimental group's pre-test and post-test scores.
- → Paired Sample T-Test was performed to determine whether there was a significant difference between the control group's pre-test and post-test scores.
- → Covariance Analysis was conducted to measure the significance of the change in participants' Preschool Scientific Process Skills after using the educational model.

Validity, Reliability, and Ethical Considerations

The Academic Ethics Committee of the university was applied to obtain the necessary permissions for administering SPST on the experimental and control groups and implementing STEM education training activities developed by the researcher. The Provincial Directorate of National Education and the school administration, where the research would be carried out, were also contacted to get the necessary permissions. After the official permissions were completed, the school administrators and the primary school teachers were met face-to-face and informed about the process. The parents were briefly informed to obtain the necessary permissions and collect demographic information while taking their children after school. Afterward, the teachers of the classes were informed by phone and message. At this point, face-to-face interviews could not be conducted with parents due to the pandemic. The General Information Form, Informed Consent Form, and Parental Leave Certificate were sent to the parents through the children. Information and permissions were collected from the parents who filled out the mentioned documents at home. Since the children in control and experimental groups were attending school regularly, no problems of absenteeism and disruption were encountered in the process.

Research Ethics

This study meets the principles of research ethics. It is a part of a master thesis and it is ensured that it addresses ethics principles and standards of scientific research. Ethical approval was obtained from the Usak University in October 2020 for "the ethics committee approval for research and publication in social sciences and humanities'' (Document date / number: 09.10.2020 / 2020-116).

FINDINGS

The following findings were taken into account within the scope of the research question, "What is the effect of STEM education training activities developed for children in early childhood on their scientific process skills?": the pre-test and post-test scores of the experimental and control groups from SPST, the findings related to the pre-test-post-test scores of the experimental group on which the developed STEM education program was implemented, and the findings related to the pre-test-post-test scores of the control group. In addition, Covariance Analysis findings were used to measure the significance of the change in participants' scientific process skills after the developed STEM education program and to control both groups' pre-test and post-test scores to predict the difference between the groups' adjusted achievement scores.

Independent groups T-Test was used to determine whether there is a significant difference between the pre-test scores of the experimental and control groups. Analysis results are presented in Table 2.

Table 2. The Results of Independent Groups T-Test Applied to SPST Pre-Test Scores

Test	Group	N	X	S.S	t	df	p
Pre-test	Experimental	10	5.70	1.70294	.594	18	.560
	Control	10	5.20	2.04396	.594	17.432	

Table 2 shows no significant difference between pre-test scores of the groups according to independent groups T-Test results ($p>0.05$). The average pre-test score of the experimental group was ($\bar{X}$=5.70), and the average of the control group was ($\bar{X}$=5.20). The average pre-test scores of both groups were close to each other.

Independent groups T-Test was used to determine whether there was a significant difference between the experimental and control groups post-test scores. Analysis results are presented in Table 3.

Table 3. The Results of Independent Groups T-Test Applied to SPST Post-Test Scores

TEST	GROUP	N	X	S.S	t	df	p
Post- Test	Experimental	10	13.70	2.05	9.879	18	.000
	Control	10	5.60	1.57	9.879	16.864	

According to Table 3, the post-test scores of the experimental group differed significantly from the control group ($p<0.05$). The experimental group scores, in which STEM education training activities consisted of 12 activities were implemented, were higher than control group scores, which were not intervened.

Paired Sample T-Test was conducted to determine whether there was a significant difference between the experimental group's pre-test and post-test scores. The results are presented in Table 4.

Table 4. Paired Sample T-Test for the Difference in SPST Pre-Test/Post-Test Scores of Experimental Group Students

EXPERIMENTAL	N	X	S	t	df	p
Pre-Test	10	5.70	1.70	-12.312	9	.000
Post-Test	10	13.70	2.05			

According to Table 4, there was a significant difference between experimental group students' pre-test and post-test scores ($p<0.05$). Regarding the arithmetic means of the participants' scores, on whom the developed STEM education program was administered, the average pre-test score was X=5.70, whereas the average post-test score was X=13.70. This result can be interpreted as STEM education training activities administered on the experimental group were quite effective in developing Preschool Scientific Process Skills.

Paired Sample T-Test was conducted to determine whether there was a significant difference between the control group's pre-test and post-test scores. The results are presented in Table 5.

Table 5. Paired Sample T-Test for the Difference in SPST Pre-Test/Post-Test Scores of Control Group Students

CONTROL	N	X	S	t	df	p
Pre-Test	10	5.20	2.04	-.739	9	.479
Post-Test	10	5.60	1.57			

According to Table 5, there was no significant difference between control group students' pre-test and post-test scores (p<0.05). Regarding the arithmetic mean scores of the participants on whom the developed STEM education program was not administered, the average pre-test score was X=5.20 and the average post-test score was X=5.60. It was concluded that no significant increase occurred in Preschool Scientific Process Skills in the absence of STEM education training activities, which consisted of 12 activities.

Table 6. Descriptive Statistics

Group	Mean	S	N
Experimental	13.7	2.05	10
Control	5.6	1.57	10
Overall	9.65	4.52	20

Regarding adjusted post-test mean scores given in Table 6, it is concluded that the averages of the experimental group were higher than the control group.

Table 7. Covariance Analysis for the Effectiveness Check of SPST Pre-Test and Post-Test (Dependent Variable: Post-Test)

	Sum of Squares	df	Mean of Squares	F	p	Effect size
Adjusted Model	342.085[a]	2	171.042	62.578	.000	.880
Intercept	97.415	1	97.415	35.641	.000	.677
Pre-Test	14.035	1	14.035	5.135	.037	.232
Group	303.362	1	303.362	110.989	.000	.867
Error	46.465	17	2.733			
Total	2251.000	20				
Adjusted Total	388.550	19				

R Square =.880 (Adjusted R Square = .866)

Regarding Table 7, the variances were homogeneously distributed (95%). There was a difference between the adjusted achievement scores of the groups. In other words, it was concluded that participants' Preschool Scientific Process Skills differed according to the teaching method. It can be said that STEM education training activities, which consists of 12 activities, positively affected participants' scientific process skills.

DISCUSSION AND CONCLUSION

To answer the research question "What is the effect of STEM education training activities developed for children in early childhood on their scientific process skills?", the difference between the pre-test and post-test scores of the children included in the study was examined. According to the data analysis, no significant difference was found between the pre-test and post-test scores of the control group, which did not receive any intervention during the study. However, there was a significant difference between the pre-test and post-test scores of the experimental group, on which STEM education training activities were administered. This difference may be attributed to the fact that STEM education training activities provided positive results on the scientific process skills of the children in the experimental group.

Scientific process skills are basic skills that facilitate people's learning, allow them to do research, and aim to take responsibility for their learning, and as a result, increase the permanence of learning (Çepni, Ayas, Johnson & Turgut, 1997). In this study, the children in the experimental group played an active role in acquiring these skills, and therefore STEM education training activities gave positive results in creating their skills. Regarding the relevant literature, this study shows parallelism with different studies in which STEM activities prepared for children in early childhood improved their scientific process skills (Abanoz, 2020; Atik, 2019; Bal, 2018; Günşen, Fazlıoğlu & Bayır, 2018; Kavak, 2019; Öcal, 2018; Ünal, 2019). Among the reviewed studies, those that used different education and training programs (constructivist approach, brain-based learning, out-of-school learning environments, project approach, Montessori method, etc.) were also effective on scientific process skills (Alabay & Özdoğan, 2018; Büyüktaşkapu, 2010; Civelek & Akamca, 2018; Özkan, 2015; Şahin, Güven & Yurdatapan, 2011; Uludağ, 2017; Üstündağ, 2019; Yağcı, 2016). Based on these results, it can be said that different programs implemented in early childhood positively affected children's scientific process skills, thus supporting the findings of this study. On the other hand, the objectives of the STEM process for raising 21st-century people include critical thinking, the ability to communicate with people in different fields, creativity and imagination skills, and scientific thinking skills (Partnership for 21st Century Skills (P21), 2019).

In this sense, according to Choi and Hong (2013), children can have the skills mentioned above after a properly designed and implemented STEM education. STEM practices also play an important role in meaningful learning, enabling people to find rational solutions to the problems encountered in daily life in line with the skills they have acquired, using scientific process skills, and to realize the objectives of the 21st century (Yıldırım & Selvi, 2018). At the same time, STEM studies on scientific process skills, conducted in primary school, provided the feedback that they created a significant difference at the end of the process (Alan, 2017; Cotabish, Daily, Robinson & Hughes, 2013; Duygu, 2018; Kavak, 2019). STEM practices administered in early childhood are very important for children to learn science in the future. Integrating children's existing scientific knowledge schemes with STEM components makes it easier for children to learn several concepts of scientific knowledge (Brenneman, Stevenson Boyd & Frede, 2009). In other words, it was observed that engineering knowledge and skills awareness, which is one of the STEM components, was developed in children studying STEM in early childhood, and they created various products after STEM education (Bagiati & Evangelou, 2018).

On the other hand, it was concluded that children have innate engineering skills, and the STEM process facilitates using these skills. The used skills put scientific process skills to work, and therefore the STEM program and/or activities had positive results on children's scientific process skills (Christenson & James, 2015; Malone, Tiarani, Irving, Kajfez, Lin, Giasi & Edmiston, 2018; Tippett and Milford, 2017). Besides, the following facts were observed in the activities planned for the STEM process and administered on the experimental group: children were allowed to learn by experience, children took the responsibility of their learning, and the teaching techniques contributed positively to children's scientific process skills. Regarding the pre-test and post-test score comparisons of the children in the experimental group, there was a significant difference in the post-test scores. In this respect, the results overlap with Chittleborough, Treagust, Mamiala and Mocerino's (2005) view that children's learning by experience in developing scientific process skills in the relevant field ensures that the activities are learned through concrete objects and facilitates their permanence.

Research findings show that STEM education training activities developed for children in early childhood effectively affect children's scientific process skills. The objectives of raising 21st-century individuals can be listed as metacognitive learning, gaining experience by doing and living, activating scientific process skills, bringing rational and scientific solutions to problems, and integrating these skills into education and daily life by using modern technologies. Considering that STEM components cover science, technology, mathematics, and engineering, they serve to raise 21st-century individuals. In this context, the conclusion that STEM studies are effective on scientific process skills derived from previous studies can be generalized for the current study. On the other hand, considering the importance of early childhood STEM practices in recent years, this study also shows the necessity of integrating STEM programs and activities with early childhood education. It shows parallelism with the studies supporting this need in the literature (Moomaw & Davis, 2010; Park, Dimitrov, Patterson & Park, 2016).

The limitations of the study are

- It is limited to the preschool classroom within a primary school affiliated to the Ministry of National Education in Usak-Turkey in the 2020-2021 academic year.
- It is limited to the data collected by SPST.

The time allocated for the implementation of STEM activities in the experimental group was six weeks. However, it was limited to two days per week due to the Covid-19 pandemic.

Recommendations

Based on the study results, the suggestions developed for new studies to be carried out are presented below. Providing STEM training for teachers working in early childhood will ensure that they are equipped with the literature and practice-oriented activities. Teachers should focus on activities that include STEM components in their classrooms, allowing children to increase the likelihood of using their scientific process skills. Within the scope of early childhood education, permanent learning should be created in children by integrating STEM components with preschool education's activity plans. This research was based on a quantitative design. It is possible to capture different clues by applying qualitative or mixed-pattern designs in future studies. Different sample groups should be selected in future studies. The research was mostly designed as a descriptive model; the effects of applied STEM programs on individuals' future lives can be examined by planning longitudinal studies. In this study, the number of participants was kept low due to the pandemic. In future studies, the number of participants should be increased and analyzed in terms of different variables. The scales involving STEM and scientific process skills are quite limited; conducting scale development studies in these areas will make important contributions to the field. Similar studies should be designed and administered to different age groups. Finally, this study was limited to six weeks and 12 activities that include STEM components, as a disadvantage brought about by the pandemic conditions. Future studies may include more activities, ensuring that the time is spread over a longer period.

Statement of Researchers

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REFERENCES

Abanoz, T. (2020). *STEM yaklaşımına uygun fen etkinliklerinin okul öncesi dönem çocuklarının bilimsel süreç becerilerine etkisinin incelenmesi [The examination of the impact of science education activities based on STEM approach on preschool term children's science process skills].* (Doctoral dissertation), Gazi University, Ankara. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 20/01/2022.

Akçay, S. (2018). *Robotik Fetemm uygulamalarının fen bilgisi öğretmen adaylarının akademik başarı, bilimsel süreç becerileri ve motivasyon üzerine etkileri [The effects of robotic Fetemm applications on academic achievement, scientific process skills and motivation of pre-service science teachers].*

(Master dissertation), Muğla Sıtkı Koçman University, Muğla. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Akçay, B. (2019). *STEM etkinliklerinin anaokuluna devam eden 6 yaş çocukların problem çözme becerilerine etkisi [The effect of STEM activities on the problemsolving skills of 6 aged preschool children].* (Master dissertation), Yıldız Technical University, İstanbul. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Akdağ, F. T., & Güneş, T. (2015). Enerji konusunda yapılan STEM uygulamaları ile ilgili Fen Lisesi öğrenci ve öğretmen görüşleri [Science High School student and teacher opinions about STEM applications on energy]. *International Journal of Social Sciences and Education Research*, *3*(5), 1643-1656. https://doi.org/10.24289/ijsser.337238

Akgündüz, D., Aydeniz, M., Çakmakçı, G., Çavaş, B., Çorlu, M., Öner, T., & Özdemir, S. (2015). STEM eğitimi Türkiye raporu: "*Günümüz modası mı yoksa gereksinim mi*?" [STEM education Turkey report: "Today's fashion or necessity?"]. İstanbul: Scala.

Akman, B., Üstün, E., & Güler, T. (2003). 6 yaş çocuklarının bilim süreçlerini kullanma yetenekleri [6-year-old children's ability to use science processes]. *Journal of Hacettepe University Education Faculty, 24*(24), 11-14. Retrieved from http://www.efdergi.hacettepe.edu.tr/yonetim/icerik/makaleler/848-published.pdf Access Date: 20/10/2021

Alabay, E. (2013). *Sciencestart destekli fen eğitim programının 60-72 aylık çocukların bilimsel süreç becerilerine ve bilimsel tutuma güvenme ve yönelme etkisi [The effect of Sciencestart supported science education program on science process skills and scientific attitude of 60-72 month old children and their orientation].* Doctoral Dissertation, Selçuk University, Konya. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Alabay, E., & Özdoğan, İ. M. (2018). Okulöncesi çocuklara dış alanda uygulanan sorgulama tabanlı bilim etkinliklerinin bilimsel süreç becerilerine etkisinin incelenmesi [Investigation of the effect of inquiry-based science activities applied to preschool children on scientific process skills]. *Trakya University Journal of Education*, *8*(3), 481-496. Retrieved from https://dergipark.org.tr/tr/pub/trkefd/issue/37181/312655 Access Date: 20/10/2021

Alan, B. (2017). *Fen bilgisi öğretmen adaylarının bütünleşik öğretmenlik bilgilerinin desteklenmesi: STEM uygulamalarına hazırlama eğitimi [Supporting pre-service science teachers' integrated teaching knowledge: preparation training for STEM applications*]. (Master dissertation), Fırat University, Elazıg. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Alan, Ü. (2020). *Okul öncesi dönem çocuklarına yönelik geliştirilen STEM eğitimi programının etkililiğinin incelenmesi [Examining the effectiveness of the STEM education program developed for preschool children]*. (Doctoral dissertation), Hacettepe University, Ankara. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/02/2022.

Altan, E. B., & Üçüncüoğlu, İ. (2018). Fen bilimleri öğretmen adayları için STEM odaklı laboratuvar uygulamaları etkinliği: sağlıklı yaşam modülüne yönelik değerlendirmeler [STEM-focused laboratory practices activity for science teacher candidates: evaluations for the healthy life module]. *Uluslararası Beşeri Bilimler ve Eğitim Dergisi*, *4*(9), 329-347. Retrieved from https://dergipark.org.tr/tr/download/article-file/566901 Access Date: 20/10/2021.

Anlıak, Ş., & Dinçer, Ç. (2005). Farklı eğitim yaklaşımları uygulayan okul öncesi eğitim kurumlarına devam eden çocukların kişiler arası problem çözme becerilerinin değerlendirilmesi [Evaluation of interpersonal problemsolving skills of children attending preschool education institutions that apply different educational approaches.]. Journal of *Ankara University Educational Sciences Faculty*, 38(1), 149-166. Retrieved from https://search.trdizin.gov.tr/yayin/detay/62067/ Access Date: 20/10/2021.

Aquilar, N. A. (2016). *Examining the integration of science, technology, engineering, and mathematics (STEM) in preschool and transitional kindergarten (TK) classrooms using a social-constructivist approach*. (Master dissertation), Mills College. Retrieved from https://www.proquest.com/docview/1799589223 Access Date: 20/10/2021.

Ata-Aktürk, A. (2019). *Development of a STEM based engineering design curriculum for parental involvement in early childhood education*. (Doctoral dissertation), Orta Doğu Technical University, Ankara. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/02/2022.

Atik, A. (2019). *STEM etkinliklerinin bilimsel süreç becerileri üzerine etkisi: 5 yaş örneği [The effect of STEM activities on science process skills: 5 year old sample].* (Master dissertation), Trabzon University, Trabzon. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/02/2022.

Aygen, M. B. (2018). *Fen bilgisi öğretmen adaylarının bütünleşik öğretmenlik bilgilerinin desteklenmesine yönelik Stem uygulamaları [Stem training activities for supporting integrated teacher knowledge of science teacher candidates].* (Master dissertation), Fırat University, Elazığ. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Ayvacı, H. Ş. (2010). Okul öncesi dönem çocuklarının bilimsel süreç becerilerini kullanma yeterliliklerini geliştirmeye yönelik pilot bir çalışma [A pilot study aimed at improving pre-school children's ability to use scientific process skills]. *Necatibey Faculty of Education Electronic Journal of Science & Mathematics Education, 4*(2), 1-24. Retrieved from https://dergipark.org.tr/tr/pub/balikesirnef/issue/3371/46524 Access Date: 20/10/2021.

Bagiati, A., & Evangelou, D. (2018). Identifying engineering in a PreK classroom: An observation protocol to support guided project-based instruction. *In Early engineering learning* (pp. 83-111). Springer, Singapore.

Bal, E. (2018). *FeTeMM (Fen, Teknoloji, Mühendislik, Matematik) etkinliklerinin 48-72 aylık okulöncesi çocuklarının bilimsel süreç ve problem çözme becerileri üzerindeki etkisinin incelenmesi [Examination of the effect of STEM (Science, Technology, Engineering, Mathematics) activities on the scientific process and proble solving skills of 48-72 month old preschool children].* Master Dissertation, Marmara University, İstanbul. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In Assessment and teaching of 21st century skills (pp. 17-66). Springer, Dordrecht.

Brenneman, K., Stevenson-Boyd, J., & Frede, E. C. (2009). Math and science in preschool: Policies and practice. *Preschool Policy Brief*, *19*, 1-12.

Büyüköztürk, Ş., Çakmak, E. K., Akgün, Ö. E., Karadeniz, Ş., & Demirel, F. (2010). *Bilimsel araştırma yöntemleri* (5. bs.) [Scientific research methods]. Ankara: Pegem.

Büyüköztürk, Ş., Kılıç Çakmak, E., Akgün, Ö. E., Karadeniz, Ş. & Demirel, F. (2018). *Bilimsel araştırma yöntemleri [Scientific research methods*]. Ankara: Pegem Akademi.

Büyüktaşkapu, S. (2010). *6 yaş çocuklarının bilimsel süreç becerilerini geliştirmeye yönelik yapılandırmacı yaklaşıma dayalı bir bilim öğretim program önerisi [A science curriculum proposal based on a constructivist approach to develop the science process skills of 6-year-old children]*. Doctoral Dissertation, Selçuk University, Konya. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Büyüktaşkapu, S., Çeliköz, N., & Akman, B. (2012). Yapılandırmacı bilim eğitimi programı'nın 6 yaş çocuklarının bilimsel süreç becerilerine etkisi [The effect of constructivist science education program on science process skills of 6-year-old children]. *Education & Sciences, 37*(165), 276-292. Retrieved from http://egitimvebilim.ted.org.tr/index.php/EB/article/view/1296/428 Access Date: 20/10/2021.

Chittleborough, G. D., Treagust, D. F., Mamiala, T. L., & Mocerino, M. (2007). Students' perceptions of the role of models in the process of science and in the process of learning. *Research in Science & Technological Education*, *23*(2), 195-212. https://doi.org/10.1080/02635140500266484

Choi, Y., & Hong, S. H. (2013). The Development and application effects of steam program about world of small organisms' unit in elementary science. *Journal of Korean Elementary Science Education*, *32*(3), 361-377. https://doi.org/10.15267/keses.2013.32.3.361

Chou, C.-P., & Bentler, PM (1995). Predictions and tests in structural equation modeling. In Hoyle, R.H. (Ed.), *Structural equation modeling: concepts, problems and applications* (pp. 37-55). Sage Publications, Inc.

Christenson, L. A., & James, J. (2015). Building bridges to understanding in a preschool classroom: A morning in the block center. *YC Young Children*, 70(1), 26. Retrieved from https://www.naeyc.org/resources/pubs/yc/mar2015/preschool-block-center Access Date: 21.01.2022.

Civelek, P., & Akamca, G. Ö. (2018). The effect of outdoor activities on scientific process skills of preschool children. *Kastamonu Education Journal*, *26*(6), 2011-2020. https://doi.org/10.24106/kefdergi.2297

Cotabish, A., Dailey, D., Robinson, A., & Hughes, G. (2013). The effects of a STEM intervention on elementary students' science knowledge and skills. *School Science and Mathematics*, 113(5), 215-226. https://doi.org/10.1111/ssm.12023

Creswell, J. W. (2017). *Araştırma deseni nitel, nicel ve karma yöntem yaklaşımları* [Research design qualitative, quantitative and mixed method approaches], *Selçuk Beşir Demir*. Ankara: Eğiten.

Çepni, S., Ayas, A., Johnson, D., & Turgut, M. F. (1997). *Fizik öğretimi [Physics teaching]*. Ankara: MEB.

Çilengir-Gültekin, S. (2019). *Okul öncesi eğitimde drama temelli erken STEM programının bilimsel süreç ve yaratıcı düşünme becerilerine etkisi [The effect of drama-based early STEM program on scientific process and creative thinking skills in preschool education]*. Master dissertation, Adnan Menderes University, Aydın. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

DeJarnette, N.K. (2012). America's children: Providing early exposure to STEM (science, technology, engineering and math) initiatives. *Education*, *133*(1), 77-84. Retrieved from https://eric.ed.gov/?id=EJ996974 Access Date: 10/01/2022.

Donnelley-Smith, A. R. (2018). *Self-Efficacy of early childhood teachers in science, technology, engineering, and mathematics (Doctoral dissertation)*, Brandman University. Retrieved from https://digitalcommons.umassglobal.edu/edd_dissertations/223?utm_source=digitalcommons.umassglobal.edu%2Fedd_dissertations%2F223&utm_medium=PDF&utm_campaign=PDFCoverPages Access Date: 10/01/2022.

Durkin, A. (2018). *Can providing young children with opportunities to participate in STEM activities encourage cooperative learning.* (Doctoral dissertation), Hofstra University. Retrieved from https://ui.adsabs.harvard.edu/abs/2018PhDT........69D/abstract Access Date: 10/01/2022.

Duygu, E. (2018). *Simülasyon tabanlı sorgulayıcı öğrenme ortamında FeTeMM eğitiminin bilimsel süreç becerileri ve FeTeMM farkındalıklarına etkisi [The effect of STEM education on scientific process skills and STEM awareness in a simulation-based inquiry learning environment]*. (Master dissertation), Kırıkkale University, Kırıkkale. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Ekici, F. Y., Bardak, Ö. G. M., & Zadeh, Ö. G. M. Y. (2018). Erken çocukluk döneminde STEM [STEM in early childhood]. In Kırkıç, K. A. & Aydın, E. (eds.), *Merhaba STEM: yenilikçi bir öğretim yaklaşımı [Hello STEM: An innovative teaching approach] (*pp. 51-78). Konya: Eğitim.

Erdoğan, S. Ç., & Baran, G. (2005). Erken çocukluk döneminde matematik [Mathematics in early childhood]. *Education & Sciences*, *28*(130), 454-485. http://dx.doi.org/10.5578/keg.8984

Floreal, R. (2019). Teachers and leaders working together towards STEM integration: An early childhood school based case study. Doctoral Dissertation, Northeastern University, Boston. Retrieved from https://search.proquest.com/docview/2234808749?accountid=15310 Access Date: 12/01/2022.

Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2011). *How to design and evaluate research in education*. New York: McGraw-Hill Humanities/Social Sciences/Languages.

Gonzalez, H. B., & Kuenzi, J. J. (2012). Science, technology, engineering, and mathematics (STEM) education: A primer. Washington, DC: Congressional Research Service, Library of Congress. https://www.fas.org/sgp/crs/misc/R42642.pdf

Gökbayrak, S., & Karışan, D. (2017). STEM temelli labaratuar etkinliklerinin fen bilgisi öğretmen adaylarının STEM farkındalıklarına etkisinin incelenmesi [Investigating the effect of STEM based laboratory activities on preservice science teacher's STEM awareness]. *Journal of Human Sciences*, *14*(4), 4275-4288. http://doi:10.14687/jhs.v14i4.5017

Günşen, G., Fazlıoğlu, Y., & Bayır, E. (2018). Yapılandırmacı yaklaşıma dayalı bilim öğretiminin 5 yaş çocuklarının bilimsel süreç becerilerine etkisi [The effect of science teaching based on constructivist approach on science process skills of 5-year-old children]. *Journal of Hacettepe Univeristy Education Faculty*, 33(3), 599-616. http://doi:10.16986/HUJE.2018036552

Gürkan, T. (2000). *Okul öncesi eğitimin tanımı, kapsamı ve önemi, Okul öncesi eğitimin ilke ve yöntemleri* [Definition, scope and importance of pre-school education, principles and methods of pre-school education]. Eskişehir: Anadolu Üniversitesi Açıkögretim Fakültesi Yayınları.

Hynes, M., Portsmore, M., Dare, E., Milto, E., Rogers, C., Hammer, D., & Carberry, A. (2011). Infusing engineering design into high school STEM courses. Retrieved from https://digitalcommons.usu.edu/ncete_publications/165 Access Date: 15/01/2022.

Kandemir, E. M., & Yılmaz, H. (2012). Öğretmenlerin üst düzey bilimsel süreç becerilerini anlama düzeylerinin belirlenmesi [Determination of teachers' understanding of high-level scientific process skills]. Western Anatolia Journal of Educational Sciences, *3*(5), 1-28. Retrieved from https://dergipark.org.tr/tr/download/article-file/39532 Access Date: 20/01/2022.

Karamustafaoğlu, S., & Kandaz, U. (2006). Okul öncesi dönemde fen etkinliklerinde kullanılan öğretim yöntemleri ve karşılaşılan güçlükler [Teaching methods and difficulties encountered in science activities in pre-school period]. *Journal of Gazi Education Faculty, 26*(1), 65-81. Retrieved from https://dergipark.org.tr/tr/pub/gefad/issue/6754/90810 Access Date: 20/03/2022.

Karasar, N. (2005). *Bilimsel araştırma yöntemleri* [Scientific research methods], Ankara: Nobel.

Kavak, T. (2019). *STEM uygulamalarının 4. Sınıf öğrencilerinin fen ve teknolojiye yönelik tutumlarına, bilimsel süreç ve problem çözme becerilerine etkisi [The effect of STEM applications on 4th grade students' attitudes towards science and technology, scientific process and problem solving skills].* (Master dissertation), Fırat University, Elazığ. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Kazakoff, E. R., Sullivan, A., & Bers, M. U. (2013). The effect of a classroom-based intensive robotics and programming workshop on sequencing ability in early childhood. *Early Childhood Education Journal, 41*(4), 245-255.

Kıldan, O., & Pektaş, M. (2009). Erken çocukluk döneminde fen ve doğa ile ilgili konuların öğretilmesinde okulöncesi öğretmenlerinin görüşlerinin belirlenmesi [Determining preschool teachers' views on teaching science and nature-related subjects in early childhood period]. *Journal of Kırşehir Education Faculty*, *10*(1), 113-127. Retrieved from https://dergipark.org.tr/en/download/article-file/1494913 Access Date: 12/11/2021.

Kuru, N., & Akman, B. (2017). Okulöncesi dönem çocuklarının bilimsel süreç becerilerinin öğretmen ve çocuk değişkenleri açısından incelenmesi [Examination of preschool children's scientific process skills in terms of teacher and child variables]. *Education & Sciences*, *42*(190), 269-279. http://dx.doi.org/10.15390/EB.2017.6433

Malone, KL., Tiarani, V., Irving, KE, Kajfez, R., Lin, H., Giasi, T., & Edmiston, B. W. (2018). Engineering design challenges in early childhood education: their impact on students' cognition and interest. *Journal of European STEM Education*, *3*(3), 11. https://doi.org/10.20897/ejsteme/3871

Milli Eğitim Bakanlığı (2016). STEM Eğitim Raporu. http://yegitek.meb.gov.tr/STEM_Egitimi_Raporu.pdf [15.02.2021].

Milli Eğitim Bakanlığı, (2018). *2023 Eğitim Vizyonu Belgesi [2023 Education Vision Document]*. https://2023vizyonu.meb.gov.tr/doc/2023_EGITIM_VIZYONU.pdf

Moomaw, S., & Davis, J. A. (2010). STEM comes to preschool. *YC Young Children*, *65*(5), 12-16. Retrieved from https://www.proquest.com/openview/849e0b687fd2e97eec102b6c42694498/1?pq-origsite=gscholar&cbl=27755 Access Date: 22/10/2021.

Moore, T. J., Stohlmann, M. S., Wang, H. H., Tank, K. M., Glancy, A. W., & Roehrig, G. H. (2014). Application and integration of engineering in K-12 STEM education. Purdue University Publications.

Öcal, S. (2018). *Okul öncesi eğitime devam eden 60-66 ay çocuklarına yönelik geliştirilen STEM programının çocukların bilimsel süreç becerilerine etkisinin incelenmesi [Investigation of the effect of the STEM program developed for 60-66 months old children attending pre-school education on children's scientific process skills.* (Master dissertation), Yıldız Technical University, İstanbul. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Özbilen, A. G. (2018). Teacher views and awareness on Stem education. *Scientific Educational Studies*, *2*(1), 1-21. Retrieved from https://dergipark.org.tr/en/download/article-file/457135 Access Date: 15/01/2022.

Özkan, B. (2015). 60-72 *Aylık çocuklar için bilimsel süreç becerileri ölçeğinin geliştirilmesi ve beyin temelli öğrenmeye dayanan fen programının bilimsel süreç becerilerine etkisi [Developing the science process skills scale for 60-72 months-old children and the effect of a science program based on brain-based learning on science process skills].* (Master dissertation), Marmara University, İstanbul. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Partnership for 21st Century Skills (P21). (2019). Partnership for 21st century skills. Retrieved from https://www.battelleforkids.org/networks/p21/21st-century-learning-exemplar-program Access Date: 21.04.2021.

Park, M. H., Dimitrov, D. M., Patterson, L. G., & Park, D. Y. (2016). Early childhood teachers' beliefs about readiness for teaching science, technology, engineering and mathematics. *Journal of Early Childhood Research*, *15*(3), 275-291. https://doi.org/10.1177/1476718X15614040

Park, D. Y., Park, M. H., & Bates, A. B. (2018). Exploring young children's understanding about the concept of volume through engineering design in a STEM activity: A case study. *International Journal of Science and Mathematics Education*, *16*(2), 275-294. http://dx.doi.org/10.1007/s10763-016-9776-0

Roehrig, G. H., Moore, T. J., Wang, H. H., & Park, M. S. (2012). Is adding the e enough? Investigating the impact of K-12 engineering standards on the implementation of STEM integration. *School Science and Mathematics*, *112*(1), 31-44. https://doi.org/10.1111/j.1949-8594.2011.00112.x

Swaid, S. I. (2015). Bringing computational thinking to STEM education. *Procedia Manufacturing*, *3*(2015), 3657-3662. http://doi:10.1016/j.promfg.2015.07.761

Şahin, F., Güven, İ., & Yurdatapan, M., (2011). Proje tabanlı eğitim uygulamalarının okul öncesi çocuklarında bilimsel süreç becerilerinin gelişimine etkisi [The effect of project-based education practices on the development of scientific process skills in preschool children]. Journal of *Marmara University Atatürk Education Faculty*, *33*(33), 157-176. Retrieved from https://dergipark.org.tr/tr/pub/maruaebd/issue/358/1982 Access Date: 21/10/2021.

Şahin, F., Yıldırım, M., Sürmeli, H., & Güven, İ. (2018). Okulöncesi öğrencilerinin bilimsel süreci becerilerinin değerlendirilmesi için bir test geliştirme çalışması [A test development study to evaluate the scientific process skills of preschool students]. *Science, Education, Art and Technology Journal (SEAT Journal),* *2*(2), 124-138. Retrieved from https://dergipark.org.tr/tr/download/article-file/624953 Access Date: 21/10/2021.

Tan, M., & Temiz, B. K. (2003). Fen öğretiminde bilimsel süreç becerilerinin yeri ve önemi [The place and importance of scientific process skills in science teaching]. Journal of *Pamukkale University Education*. *13*(1), 89-101. Retrieved from https://dergipark.org.tr/tr/download/article-file/114823 Access Date: 21/02/2022.

Tao, Y. (2019). Kindergarten teachers' attitudes toward and confidence for integrated STEM education. *Journal for STEM Education Research*, *2*(2), 154-171. https://doi.org/10.1007/s41979-019-00017-8

Tippett, C. D., & Milford, T. M. (2017). Findings from a pre-kindergarten classroom: Making the case for STEM in early childhood education. *International Journal of Science and Mathematics Education*, *15*(1), 67-86. http://dx.doi.org/10.1007/s10763-017-9812-8

Uludağ, G. (2017). *Okul dışı öğrenme ortamlarının fen eğitiminde kullanılmasının okul öncesi dönemdeki çocukların bilimsel süreç becerilerine etkisi [The Effect of using out-of-school learning environments in science education on preschool children's science process Skill].* (Doctoral dissertation), Hacettepe University, Ankara. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Ünal, M. (2019). *4-6 yaş okul öncesi çocuklarına etkinlik temelli STEM eğitiminin bilimsel süreç becerilerine etkisinin incelenmesi [Investigation of the effect of activity-based STEM education on scientific process skills of preschool children aged 4-6].* (Master dissertation), Bolu Abant İzzet Baysal University, Bolu. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Üstündağ, K. (2019*). Montessori yönteminin okul öncesi dönemdeki çocukların bilimsel süreç becerilerine etkisinin incelenmesi [Investigation of the Effect of Montessori method on preschool children's science process skills]*. (Master dissertation), Necmettin Erbakan University, Konya. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Vurucu, C. (2019). *Erken çocukluk döneminde bilim ve mühendislik uygulamalarının öğrencilerin bilimsel süreç becerilerine, karar verme ve problem çözme becerilerine etkisi [The effect of science and engineering practices in early childhood on students' scientific process skills, decision making and problemsolving skills]*. (Master dissertation), Marmara University, İstanbul. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Yağcı, M. (2016). *Okul öncesi dönem çocuklarının bilimsel süreç becerilerinin gelişmesinde doğa ve çevre uygulamalarının etkisinin incelenmesi [Examination of the effects of nature and environmental practices on the development of scientific process skills of preschool children].* (Master dissertation), Abant İzzet Baysal University, Bolu. Retrieved from https://tez.yok.gov.tr/UlusalTezMerkezi/ 22/01/2022.

Yıldırım, B., & Altun, Y. (2015). STEM eğitim ve mühendislik uygulamalarının fen bilgisi laboratuar dersindeki etkilerinin incelenmesi [Examining the effects of STEM education and engineering applications in science laboratory course]. *El-Cezeri Journal of Science and Engineering*, *2*(2), 28-40. Retrieved from https://dergipark.org.tr/tr/download/article-file/56981 Access Date: 22/01/2022.

Yıldırım, B., & Selvi, M. (2017). Stem uygulamaları ve tam öğrenmenin etkileri üzerine deneysel bir çalışma. *Eğitimde Kuram ve Uygulama [An experimental study on the effects of Stem applications and mastery learning. Theory and Practice in Education]*, *13*(2), 183-210. https://doi.org/10.17244/eku.310143

Yıldırım, B., & Selvi, M. (2018). Ortaokul öğrencilerinin STEM uygulamalarına yönelik görüşlerinin incelenmesi [Examination of secondary school students' views on STEM applications]. *Journal of Social Sciences of Mus Alparslan University*, *6*(STEMES'18), 47-54. https://doi.org/10.18506/anemon.471037

Yılmaz, A., Gülgün, C., & Çağlar, A. (2017). 7. Sınıf öğrencilerine "Kuvvet ve Enerji" ünitesinin STEM uygulamaları ile öğretimi: Paraşüt, sujeti, mancınık, akıllı perde ve hidrolik iş makinesi (kepçe) yapalım etkinliği [Teaching the "Force and Energy" unit to 7th grade students with STEM applications: Let's make a parachute, waterjet, catapult, smart curtain and hydraulic work machine (bucket) activity]. *Journal of Current Researches on Educational Studies*, *7*(1), 97-116. Retrieved from https://dergipark.org.tr/tr/download/article-file/670815 Access Date: 21/11/2021.

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