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Mother-Child Interactive Science Practices: Improving Mothers' Scientific Literacy and Children's Scientific Creativity

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Abstract

The aim of this study is to improve mothers' scientific literacy and children's scientific creativity through science practices based on mother-child interaction. For this purpose, a training program based on mother-child interaction and including scientific experiments and activities that can be done at home and at school was prepared. The study was designed in a quasi-experimental design within the framework of quantitative research methodology. The participants were 62 mothers and their children (62 children) who had primary school 4th-grade level children in a public primary school. The data of the study, which lasted 6 months during the 2021-2022 academic year, were collected with the Scientific Literacy Test and the Scientific Creativity Test. The results obtained from the study indicate that the science practices training program based on mother-child interaction increased the scientific literacy level of mothers. In addition, it was concluded that mother-child interactive activities were more effective in children's scientific creativity dimensions such as scientific imagination, creative experimental ability, and creative scientific product design skill. Also, it was determined that the children of mothers with high levels of scientific literacy showed higher success in all sub-dimensions of scientific creativity compared to their controls.

Keywords: Mother training program, mother-child interaction, scientific literacy, scientific creativity in primary school.

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Anne-Çocuk Etkileşimli Bilim Uygulamaları: Annelerin Bilimsel Okuryazarlığı ve Çocukların Bilimsel Yaratıcılıklarının Geliştirilmesi

Makale Türü	Başvuru Tarihi	Kabul Tarihi
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Öz

Bu çalışmanın amacı, anne-çocuk etkileşimine dayalı bilim uygulamaları yoluyla annelerin bilimsel okuryazarlıklarını ve çocukların bilimsel yaratıcılıklarını geliştirmektir. Bu amaç doğrultusunda anne-çocuk etkileşimli bilimsel deney ve etkinlikler içeren uygulamalı ve teorik bir eğitim programı hazırlanmıştır. Çalışma nicel araştırma metodolojisi çerçevesinde ön test-son test kontrol gruplu yarı deneysel desende tasarlanmıştır. Katılımcılar, bir devlet okulunun ilkokul 4. sınıf düzeyinde çocuğu olan 62 anne ve çocuklarıdır (62 çocuk). 2021-2022 eğitim öğretim döneminde altı ay süren çalışmanın verileri Bilimsel Okuryazarlık Testi ve Bilimsel Yaratıcılık Testi ile toplanmıştır. Çalışmadan elde edilen sonuçlar, anne-çocuk etkileşimine dayalı bilim uygulamaları eğitim programının annelerin bilimsel okuryazarlık düzeyini artırdığını göstermektedir. Ayrıca anne-çocuk etkileşimli etkinliklerin çocukların bilimsel hayal gücü, yaratıcı deneysel yetenek ve yaratıcı bilimsel ürün tasarlama becerisi gibi bilimsel yaratıcılık boyutlarında daha etkili olduğu sonucuna ulaşılmıştır. Bununla birlikte, bilimsel okuryazarlık düzeyi yüksek olan annelerin çocuklarının bilimsel yaratıcılığın tüm alt boyutlarında kontrollerine nazaran daha yüksek başarı gösterdiği belirlenmiştir.

Anahtar Sözcükler: Anne eğitim programı, anne-çocuk etkileşimi, bilimsel okuryazarlık, ilkokulda bilimsel yaratıcılık.

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Introduction

In raising 21st-century citizens, the goals of education systems are quite different compared to those of the previous century. Creative thinking is at the top of the list of skills expected of individuals in this new century (Organisation for Economic Co-operation and Development [OECD], 2019; The World Economic Forum [WEF], 2020). Given the pace of change and the number and diversity of expectations placed on individuals, the importance of creativity has never been greater (Puccio et al., 2011). Moreover, the reflections of this importance attributed to creativity in education have rapidly emerged. So much so that OECD (2019) stated that Creative Thinking Skills will also be investigated in the 2022 session of the Programme for International Student Assessment (PISA) study, which is an international education indicator of science, mathematics, and reading comprehension. Also, the World Economic Forum (WEF) includes creative thinking as one of the top 15 skills for 2025 in its Future of Jobs research report published in 2020, which points to the importance of teaching creative thinking. On the other hand, research indicates that creativity is contextual (Runco, 2017) and that creativity has domain-specific components (Alexander, 1992; Amabile & Gryskiewicz, 1989). In this context, the term "scientific creativity" (Meyer & Lederman, 2013, p.400) is used in the field of science education. Because solving problems, generating hypotheses, experimental design and technical innovation all require a special form of creativity that is unique to science (Lin et al., 2003). Hu and Adey (2002) use the following argument to justify scientific creativity;

> *"Almost by definition, scientific research requires creativity in the sense of going beyond existing knowledge and techniques, of creating new understandings. But even at a more mundane level, solving problems in science requires a student to explore his or her repertoire, to imagine a variety of routes to a solution, and frequently to create novel combinations of knowledge or novel techniques for a solution." (p. 389).*

According to Lee and Park (2021), a student's scientific creativity is influenced by cognitive, affective, attitudinal, and environmental factors (p.67). Perhaps the most important of these is the child's first environment, the family, and especially the mother. In this study, we focused on mothers' scientific literacy as a factor in developing children's scientific creativity. The most important influence in determining this focus is the transfer of school activities to the home with the COVID-19 pandemic because the influence of mothers on their children has increased, especially during the distance education periods. This has led us to rethink the impact of mothers' attitudes in encouraging children's creativity. The majority of the research of the past years has referred to the quality of the child's environment in developing creativity (Csikszentmihalyi, 1996; Szarka, 2012; Sternberg & Ohara, 2000). However, results from the 2019 TIMSS survey show that students with more education and parents who provide resources and activities at home have greater average achievement in science in both 4th and 8th grade (Mullis et al., 2020). Studies conducted with adolescents state that the attitude of the family is an important factor in the acquisition of skills and habits that enable individuals to develop problem-solving skills (Arslan & Kabasakal, 2013). Datta and Parloff (1967) conducted research regarding the relationship between children and their parents in terms of scientific creativity and discovered that both highly creative young scientists and their comparably intelligent but less talented peers described their parents as tending to promote intellectual autonomy. However, Runco et al. (2017) found that despite science and technology education at school, students in the Turkish sample exhibited more creative skills outside of school. This reveals the importance of providing an atmosphere that is more supportive of children's scientific creativity in informal settings. This is because the experiences and knowledge that children acquire in the climate in which they live provide them with raw materials for further creative processes (Kwaśniewska, 2019). Saptano and Hidayah (2020) reviewed the literature on scientific creativity between 2001 and 2019 and found that the most studied topics related to scientific creativity were test development, teacher perceptions, scientific creativity level, the relationship between variables, and instructional strategies. It is noteworthy that Saptano and Hidayah's (2020) meta-analysis did not mention the "home-parent" dimension in scientific creativity studies. Examining the distinction between creativity within the classroom and outside the classroom is a chance to employ educational experiences to realize creative potential. Research shows that teachers and parents consider divergent thinking, independence, curiosity, experimenting to solve problems, questioning, and sharing ideas as crucial for scientific creativity (Liu & Lin, 2014; Lee & Park, 2021; Park & Jee, 2015). Park and Jee (2015) stated that parents' perceptions and attitudes towards scientific creativity can also affect scientific creativity. Therefore, improving the scientific literacy of mothers, especially those from lower socio-cultural levels, and enriching the time the child spends with their mother with scientific activities can increase the potential for scientific creativity in children. In this respect, the idea of developing and supporting mothers' scientific literacy was a driving force in conducting this study, as it could improve children's scientific creativity.

Based on all these explanations, a child-mother interactive training program was designed for mothers with low socio-cultural/economic status to improve their science literacy. Thus, based on the findings that field-specific knowledge and skills are an important component of creativity (Hu & Adey, 2002) and that child-family interaction is effective in the development of creativity (Harrington et al., 1987; Miller et al., 2012; Runco & Albert, 2005), it was aimed at improving the scientific creativity of primary school children. The value attributed to science in the child's home and coming from a scientifically literate environment may be a factor in the improvement of scientific creativity, which has been the subject of curiosity for this research. In this context, the research questions are as follows.

1) Is there a statistical difference between the scientific literacy of the experimental and control groups of mothers?
2) Is there a statistical difference between the scientific creativity of the experimental and control groups of children?
3) What are the scientific creativity levels of the children in the experimental group according to the sub-dimensions before and after the implementation?
4) Is there a statistical difference between children's scientific creativity test scores and mothers' scientific literacy test scores after the implementation?

Method

Research Method

This is a quasi-experimental study with a pre-test post-test control group. In the pretest posttest control group design, two groups are formed by random assignment as experimental and control groups, and measurements are made in these groups before and after the experiment (Karasar, 2012). Creswel (2003) draws attention to the fact that in quasi-experimental designs with pre-test and post-test applied experimental and control groups, participants should be randomly assigned. In this direction, thirty-two of 76 mothers who applied to the mother-child science practices training program were randomly selected, which is the experimental-mother group. The experimental-child group was formed with the children of the randomly selected mothers. Among the mothers who were not selected for the training program, 32 were randomly assigned to the control-mother group and their children to the control-child group. After this distribution, two mothers in the control group withdrew due to health problems. The science practices education program was implemented with the mothers and children in the experimental group for six months in the 2021-2022 academic year.

Study Group

Primary school grade 4th students and their mothers from a public school at the research. The main criterion for selecting a public school was the selection of a school in a socio-economically and socio-culturally disadvantaged region. In this context, 62 mothers and their children (62) participated in the study. The number of mothers who graduated from middle and high schools was dominant. None of the mothers had any profession and were working. Most of the mothers and children participating in the study were receiving financial government support. Information about the experimental and control groups is presented in Table 1.

Table 1

Information on the Mothers and Children in the Study Group

Group	Number of Students		Group	Mothers' Education Status			Total
	Girl	Boy		Primary School	Middle School	High School	
Experimental-C	15	17	Experimental-M	5	16	11	32
Control-C	14	16	Control-M	6	14	10	30

* *Note:* In the table, C stands for Children, and M stands for Mothers.

Data Collection Tools

Scientific literacy test

In the study, the Scale for Determining the Scientific Literacy of Turkish Society (SLT) developed by Karataş et al. (2019) as part of a TUBITAK project was used to determine the scientific literacy of pre-service primary school teachers. The 36-item scale aims to develop a tool suitable for the definition of 21st-century scientific literacy in the light of the opinions of experts using the Delphi technique and to determine the scientific literacy levels of Turkish citizens aged 18-65 (Karataş et al., 2019). Participants receive one point for the correct answer and zero for all other possibilities. Cronbach's Alpha value of the original test was 0.80. In this study, Cronbach's Alpha value of the trial was 0.85 based on the pre-test conducted on 62 mothers.

Scientific creativity test

The version of the Scientific Creativity Test (SCT) developed by Hu and Adey (2002) and adapted into Turkish by Deniş-Çeliker and Balım (2012) was used to determine children's scientific creativity. Pilot implementations of the seven-item SCT were conducted with 389 middle school students, and Cronbach's Alpha coefficient of the scale was 0.86 (Deniş-Çeliker & Balım, 2012). The validity and reliability study of the Scientific Creativity Scale (Hu & Adey, 2002) for the fourth grade of primary school was carried out by Asal (2020), and the Cronbach alpha coefficient was found to be 0.74. Within the framework of this study, the Cronbach's alpha coefficient of the SCT was found to be 0.78. In addition, it is seen that the SCT was applied to primary school 4th-grade students in both national and international studies (Asal, 2020; Baysal et al., 2013; Gülay & Özsevgeç, 2017).The SCT consists of seven open-ended questions, and each item in the scale covers more than one sub-dimension: Item 1 - the use of objects for a scientific purpose; Item 2 - the degree of sensitivity to scientific problems; Item 3 - students' ability to design technical products; Item 4 - students' scientific imagination; Item 5 - students' creative scientific solving ability; Item 6 - creative experimental ability; and Item 7 - students' ability to design creative scientific products. Also, when the evaluation principles of the scale items are examined (Hu & Adey, 2002), there is no maximum scoring limit in the scale. Because the answers that the student can give to the relevant question are proportional to the skills specified in the sub-dimensions of the scale, and there is no limit.

Data Analysis

The Scientific Literacy Test (SLT) has multiple-choice items, and they are scored according to the answer key prepared by Karataş et al. (2019). In the analysis of the SCT, student statements were coded independently by the researcher and a teacher who is an expert in science education, their frequencies were specified, and they were scored in accordance with the scale (Hu & Adey, 2002). In the analysis of the data obtained from the study, mean, standard deviation, and t-test analyses were used to determine whether there was a difference in the SLT and SCT pre- and post-test scores according to the group (experimental/control) independent variable, and to compare the SCT results of the children in the experimental and control groups according to mothers' scientific literacy score after the implementation. In order to determine whether the method was effective in the difference between the groups, the Cohen-d effect size value was calculated in addition to statistical significance. For the interpretation of Cohen's d, the effect size d value is stated as small for 0.2, medium for 0.5, large for 0.8, and very large for above 1 (Cohen, 1992). A p-value>0.05 was considered statistical. SPSS 25.00 was used for data analysis.

Implementation Process

Before starting the training, the training modules were shared by the school management through posters and school WhatsApp groups, and the modules were introduced. Consent for voluntary participation was obtained from all mothers and their children participating in the study. The Science Practices Education Program was implemented with the mothers of the experimental group for six months. The Science Practices Education Program consists of 2 stages. The first phase included theoretical and practical training with the mothers. The implementation process of this phase lasted one month. In this context, 3-hour trainings were held twice a week. The second phase included training activities that included experiments based on the interactions between mothers and children. The training was conducted outside of school hours in a classroom. In addition to the trainings at the school, a WhatsApp group was created for mother-child interactive experiments. Mothers and children videotaped and shared the experiments they conducted together. They also shared the questions they wanted to ask in this group. In designing the mother-child interactive science practices, the Ministry of National Education (MoNE) Science Curriculum (2018) was accepted as the framework, and care was taken to design the experiments according to the level of primary school students. Each experiment was designed within a daily life context. In the implementations based on mother-child interaction, the researcher guided mothers and children in the classroom. The WhatsApp group was also used to guide the experiments conducted at home. Worksheets were prepared by the researcher to conduct the experiments. The design of the worksheets was based on the scientific process skills steps. There were 11 theoretical courses in the first phase and 29 activities/experiments in the second phase of the 144-hour mother-child interactive Science Practices Training Program (Appendix).

Results

In this section, statistical analyses revealing the equivalence of the experimental and control groups participating in the study before the implementation are included. In addition, the findings and interpretations obtained from the analysis of the tests applied to determine the effects of science practices based on mother-child interaction on mothers' scientific literacy and children's scientific creativity are included.

Before the analyses, test scores were subjected to normality analysis. In this framework, the findings regarding the normality analysis of the data are presented in Table 2.

Table 2

Findings Related to Normality Analysis of Scores

	Shapiro-Wilks		
	Statistics	**df**	**Sig.**
Experiment-M SLT Pre-test Scores	.912	29	.221
Experiment-M SLT Post-test Scores	.927	29	.350
Control-M SLT Pre-test Scores	.923	27	.654
Control-M SLT Post-test Scores	.956	27	.478
Experiment-C SCT Pre-test Scores	.973	29	.139
Experiment-C SCT Post-test Scores	.962	29	.296
Control-C SCT Pre-test Scores	.945	27	.782
Control-C SCT Post-test Scores	.932	27	.403

Shapiro-Wilks test was used in the normality analysis since the group size was less than 50 (Büyüköztürk, 2014). Shapiro-Wilks coefficients were greater than 0.05 significance value (Table 2). According to the results, the data conform to normal distribution.

Findings Related to the Equivalence of Experimental and Control Groups Before the Implementation

First of all, the pre-test scores of all mothers in both groups on the SLT were analyzed. Whether there was a statistical difference between the pre-test mean scores of the experimental and control groups was analyzed with the Unpaired Samples t-Test due to the normal distribution of the scores. The findings related to the analysis are presented in Table 3.

Table 3

T-Test Results of Mothers' SLT Pre-Tests

Test	Group	*N*	$\bar{X}$	*S*	*SD*	*t*	*p*
SLT	Experimental-M	32	9.74	2.14	60	.292	.223
	Control-M	30	9.38	1.98			

*p>0.05

There is no statistical difference between the SLT pre-test scores of the experimental and control groups (Table 3) [$t(60)=-2.29$, $p>.05$]. Accordingly, the experimental and control groups are equivalent in terms of SLT pre-test scores.

On the other hand, the pre-test scores of the children in the experimental and control groups on the SCT were analyzed before the implementation. In this direction, whether there was a statistical difference between the pre-test mean scores of the experimental and control groups was analyzed with the Unpaired Samples t-Test due to the normal distribution of the scores. The findings related to the analysis are presented in Table 4.

Table 4

T-Test Results of Children's SCT Pre-Tests

Test	Group	*N*	$\bar{X}$	*S*	*SD*	*t*	*p*
SCT	Experimental-C	32	47.07	14.39	60	.251	.864
	Control-C	30	46.73	15.88			

*p>0.05

There was no statistical difference between the pre-test scores of the experimental and control groups in terms of SCT [$t(60)$=,332, $p>.05$]. Accordingly, the experimental and control groups were similar in terms of SCT pre-test scores.

After determining that the experimental and control groups including mothers and children were equivalent groups in terms of pretests, the analyses related to the sub-problems of the study were started.

Findings of the First Sub-Problem

In the first sub-problem of the study, it was aimed to determine the effect of the practices on mothers' scientific literacy level. Whether there was a statistical difference between the mean SLT posttest scores of the experimental and control mother groups were examined. Findings are presented in Table 5.

Table 5

T-Test Results of SLT Post-Tests of Experimental-M and Control-M Groups

Test	Group	*N*	$\bar{X}$	*S*	*SD*	*t*	*p*
SLT	Experimental-M	32	22.12	6.19	60	4.292	.001
	Control-M	30	10.27	3.12			

*p>0.05

There was a statistical difference between the mean SCT posttest scores of the experimental and control groups [$t(60)=5.409$, $p>.05$] (Table 4). The difference is in the experimental group's with mother favor.

Findings of the Second Sub-Problem

The second sub-problem of the study aimed to determine the effects of the practices on children's scientific creativity. Whether there was a statistical difference between the mean SCT posttest scores of the experimental and control groups was examined. The findings related to the unrelated samples t-test are presented in Table 6.

Table 6

T-Test Results for the SCT Post-Tests of the Experimental-C and Control-C Groups

Test	Group	*N*	$\bar{X}$	*S*	*SD*	*t*	*p*
SCT	Experimental-C	32	120.68	26.74	60	5.462	.001
	Control-C	30	49.19	15.99			

*$p>0.05$

There is a statistical difference between the SCT posttest mean scores of the experimental and control groups [$t(60)=5,409$, $p>.05$] (Table 6). The difference is in the experimental group's with children favor.

Findings of the Third Sub-Problem

In the third sub-problem of the study, the SCT scores of the children in the experimental group according to its sub-dimensions before and after the practices were examined. In this context, the descriptive statistics of the items in the pre-posttest of the scientific creativity scale in terms of the skills it aims to measure are presented in Table 7.

Table 7

Descriptive Statistics of the Scores of the Children in the Experimental Group on the Pre- and Post-Test Sub-scales of the SCT

Test	Sub-dimensions	*N*	$\bar{X}$	*SD*	Min	Max	$\bar{X}_2$- $\bar{X}_1$
SCT Pre-test	Using Objects for a Scientific Purpose	32	6.34	3.22	1	14	
	Sensitivity to the Scientific Problem	32	8.08	3.47	1	21	
	Ability to Design Technical Products	32	7.67	4.53	2	16	
	Scientific Imagination	32	6.44	4.21	1	18	
	Creative Scientific Problem-Solving Ability	32	7.52	3.12	2	20	
	Creative Experimental Ability	32	5.23	3.67	2	17	
	Ability to Design Creative Scientific Products	32	5.79	4.19	1	16	
	Total	32	47.07	14.39	20	81	
SCT Post-test	Using Objects for a Scientific Purpose	32	12.88	9.27	5	34	6.54
	Sensitivity to the Scientific Problem	32	14.73	12.65	6	38	6.65
	Ability to Design Technical Products	32	16.20	10.97	6	31	8.33
	Scientific Imagination	32	18.89	11.21	8	34	12.45
	Creative Scientific Problem-Solving Ability	32	16.66	10.69	7	25	9.14
	Creative Experimental Ability	32	19.57	11.91	6	46	14.34
	Ability to Design Creative Scientific Products	32	21.75	9.87	7	35	15.96
	Total	32	120.6	26.74	58	186	73.61

* *$\bar{X}_1$ and $\bar{X}_2$ represent the mean of the items in the pre-test and the mean of the items in the post-test, respectively.*

The minimum and maximum SCT scores were 20 and 81. The average SCT pre-test score was 47.07 (Table 7). The minimum and maximum SCT posttest scores were 58 and 186. When the mean scores of the children in the experimental group from the pre-test of the SCT were analyzed according to the sub-dimensions of the scale, all mean scores had close values. When the post-tests are analyzed, it is seen that the sub-dimensions with the highest increase in the mean scores of the students are

Scientific Imagination ($\bar{X}2$- $\bar{X}1$=12.45), Creative Experimental Ability ($\bar{X}2$- $\bar{X}1$ =14.34), and Creative Scientific Product Design Skill ($\bar{X}2$- $\bar{X}1$ =15.96). In addition, it is seen that the increase in the SCT post-test mean score compared to the pre-test mean score was 73.61.

Findings of the Fourth Sub-Problem

In the fourth sub-problem of the study, whether there was a statistical difference between the SCT sub-dimension scores of the children in the experimental and control groups and their mothers' scientific literacy was examined. The finding related to the first sub-problem was taken as a reference in the classification of mothers' scientific literacy. The scientific literacy levels of the mothers of the experimental group were high, while the scientific literacy levels of the mothers of the control group were low. It was examined how children's scientific creativity levels changed according to whether their mothers were in the experimental or control group. The t-test results of children's scientific creativity according to their mothers' scientific literacy levels are presented in Table 8.

Table 8

T-Test Analyses of Children's Scientific Creativity Scale Subscale Scores According to Mothers' Scientific Literacy Level

Test	Sub-dimensions	Mothers' Scientific Literacy Level	*N*	$\bar{X}$	*SD*	*t*	*p*	Cohen's d
Scientific Creativity	Using Objects for a Scientific Purpose	Experimental-M Control-M	32 30	12.88 6.01	9.27	4.788	.000	.81
	Sensitivity to the Scientific Problem	Experimental-M Control-M	32 30	14.73 7.08	12.65	5.109	.000	1.11
	Ability to Design Technical Products	Experimental-M Control-M	32 30	16.20 6.88	10.97	4.390	.000	.72
	Scientific Imagination	Experimental-M Control-M	32 30	18.89 7.66	11.21	4.652	.000	.98
	Creative Scientific Problem-Solving Ability	Experimental-M Control-M	32 30	16.66 7.52	10.69	5.344	.000	.92
	Creative Experimental Ability	Experimental-M Control-M	32 30	19.57 8.25	11.91	5.087	.000	1.01
	Ability to Design Creative Scientific Products	Experimental-M Control-M	32 30	21.75 5.79	9.87	4.304	.000	.94

*p>0.05

There was a statistical difference between all sub-dimensions of SCT and mothers' scientific literacy ($p<0.05$) (Table 8). The mean SCT posttest scores of the children were in favor of the children of the mothers in the experimental group in all sub-dimensions. Cohen's d values of the effect size showed that mothers' scientific literacy level had a high-level effect on the child's Use of Objects for a Scientific Purpose (.81), Sensitivity to Scientific Problems (1.11), Scientific Imagination (.98), Creative Scientific Problem Solving Ability (.92), Creative Experimental Ability (1.01), and Creative Scientific Product Designing Ability (.94), while it had a medium level effect (.72) on Technical Product Designing Ability.

Discussion, Conclusion and Recommendations

In this study, a mother-child education program was designed to improve the scientific literacy level of mothers and thus to develop children's scientific creativity. In this context, the results obtained from the study are discussed in terms of the scientific literacy levels of mothers, children's scientific creativity levels, and the results of the change process of children's scientific creativity levels according to mothers' scientific literacy.

The first result of the study is that the program increased mothers' scientific literacy levels. There are various family education programs in the literature (Barlow et al., 2012; Tavil & Karasu, 2013; Tönbül, 2019; Manav et al., 2021). However, there exist no structured training programs specifically aimed at improving the scientific literacy of mothers. In this respect, the implementation process of the study and the result of the development of mothers' scientific literacy at the end of this process are unique in the field. According to OECD data, the rate of women aged 25-34 with secondary education is 37% in Türkiye, whereas the global OECD average is 12% indicating the education level of today's young adult mothers in Turkey (tedmem, 2022), Considering that the education level of the mothers who participated in the study is at the secondary education level and below, it is important to support the scientific literacy of mothers to create a society promoting to science. National Science Teachers Association (NSTA, 2014) states that adults play a central role in children's learning of science and that parents' scientific literacy levels and attitudes toward science education have a decisive influence on children's early science experiences. As Brossard and Shanahan (2006) state, a scientifically literate population is needed for the proper realization of democratic processes in an increasingly technologically demanding society. Therefore, providing mothers with a scientific perspective is an important investment for children. Moreover, today's denial of scientific knowledge, such as the coronavirus pandemic, and the unreliable sources of information about the techno-scientific risks we are exposed to every day, are a warning to revitalize the global commitment to scientific literacy (Valladares, 2021).

Another result obtained in the study was that the education program improved children's scientific creativity. In this study, an enriched science education program was presented to the child at home. Thus, in the process, the child embarked on a qualified science learning journey with their mother. In the literature, in addition to studies examining the relationship between scientific creativity according to variables such as gender, grade level, science achievement, parental education level, etc. (Baysal et al., 2013; Kılıç & Tezel, 2012; Liang, 2002; Matud et al., 2007), there are also studies examining the positive effects of various teaching practices on children's scientific creativity levels (Hu et al., 2013; Lin et al., 2003). Runco et al. (2017) found that students in a Turkish sample demonstrated more creative skills outside of school. This research followed a process that nurtured the child's informal environment in developing scientific creativity. Therefore, a novel result is that mother-child interactive activities have a positive effect on developing scientific creativity. This effect was higher in the Scientific Imagination, Creative Experimental Ability, and Creative Scientific Product Design Skill dimensions of scientific creativity. In this result, it is thought that the content of science practices education based on mother-child interaction is effective. As a matter of fact, when the educational practices of this study are examined, design-oriented experiments that prioritize the child's sense of curiosity, where scientific process skills are used effectively, and design-oriented experiments are included.

One of the important results of the study was that there was a statistical difference between mothers' scientific literacy and all sub-dimensions of scientific creativity. Children of mothers with high levels of scientific literacy showed higher success in all sub-dimensions compared to controls. Furthermore, the impact value of maternal science literacy on this achievement is also quite high. Tennent and Berthelsen (1997) highlighted that creative people grow up in families encouraging innovation and diversity. Quality science education that young children receive at an early age can accompany their already innate sense of curiosity and desire to explore, creating opportunities for them to understand the world and test their own predictions and theories about the world, and can create an interest in science at an early age and a positive attitude later in life (Broström, 2015). Studies advocating the positive effects of family climate in developing children's creativity emphasize spending quality time with the child, encouraging the child to develop new interests, accepting the child's incompatibilities, providing an environment for the child's independent experimentation, and supporting the child's imagination (Bloom & Sosniak, 1981; Gardner, 1993; Gute et al., 2008). In this study, it was seen that scientific creativity, which is a domain-specific component of creativity, can be improved through interactive scientific activities that support mothers' scientific literacy. From this point of view, it can be suggested that activities, projects, and programs that bring science into the home, introduce parents to the applicable and fun aspects of science, and support parent-child interaction should be expanded in raising creative children.

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Appendix

Science Practices Training Program

Phase	Training/Experiments Implemented	Duration
First Phase/Theoretical	• Scientific literacy: Science for the People • How Can I Improve My Scientific literacy? • Awareness Raising Resources in Science and Scientific literacy: Web, Books, Magazines, Applications • Children, Science, and Scientific Attitude • Parents' Roles in Giving Children a Scientific Perspective • Science in Primary School - How to Guide Little Scientists? • The Role of the Family in Raising Inquisitive Children • How Can I Make My Child Aware of Nature and the Environment? • What is STEM? How Can I Support My Child's STEM Skills? • Chemicals in Daily Life - What Parents Should Pay Attention to! • Label Reading for a Healthy Generation (Chemicals, Food and Drinks)	24 hours
Second Phase/Application	• Journey to the Micro World: Why Should We Wash Our Hands? • Where Are These Germs? Cool Mushroom Experiment • Global Epidemics: Vaccine, Immunization, Immunity • Which one travels farther? Friction Force • Forces we cannot see with our eyes: Water Resistance • Weather Observation: Wind Rose - Rain Gauge - Air Pressure Measurement • The Ball in the Balloon? An acid and base reaction • Family and Family Ties: Can We See DNA? • Dancing Peppercorns: Sound Vibrations - Measuring Sound Level • Treble and Pes Sounds: Let's Make a Guitar • In the Name of the Power of Sound: How Did the Glasses Tip Over? • Can We See Sound? • Plant Life Cycle - Let's Collect Data! • Let's Observe the Effect of Light on Photosynthesis • Let's Observe Air Pressure with the Egg in a Bottle Experiment • A Diver Under Pressure! • Paper that Doesn't Get Wet • The Balloon that Moves the Ship: Static Electricity • Let's Make a Model of the Solar System • Lunar and Solar Eclipse • How Does the Kidney Work? Kidney Dissection • How Does Our Eye See? Eye Dissection • The Structure of Bone: How Do We Move? • Let's Observe Global Warming with Experiments • Let's Observe Air Pollution • Let's Make Environmentally Friendly Detergent • Earthquake Experiment at Different Intensities • Light Pollution: Monitor Your City • Sound Pollution: Let's Listen to Our Environment	120 hours