

The Effects of the Mathematics Education Program Supported by Stories on the Mathematical Skills of 48–60-Month-old Children

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Abstract

This study aims to develop a mathematics education program supported by stories for 48–60-month-old children attending pre-school education institutions and examine its effect on children's early mathematics skills. The study group consists of 48–60-month-old children who continue pre-school education in an independent kindergarten affiliated with the Ministry of National Education in Uşak province, in 2020-2021. The study was carried out with 33 children, 18 in the experimental and 15 in the control group. A pretest-posttest quasi-experimental design with a control group was used in the study. Test of Early Mathematics Ability -3 (TEMA-3), developed by Ginsburg and Barody, was used to collect data. The test's adaptation, validity, and reliability to 48-60-month-old Turkish children had been conducted by Seker (2013). Regarding data collection, TEMA-3 was administered as a pre-test to the experimental and control group students before implementing the program. After the pre-test, the "Mathematics Education Program Supported by Stories" was instructed to the experimental group three (3) days a week for eight (8) weeks. During the implementation, "Mathematics Education Program Supported by Stories" was instructed to the children in the experimental group by the researcher; the daily education flow specified in the 2013 Pre-School Education Program was continued for the control group children. The data obtained from the research were analyzed with the SPSS statistical program. Independent and dependent t-tests were used to test the difference between the pre-test and post-test between and within groups. Based on the findings obtained from the analyzes, there was no significant difference between the pre-test scores. However, there was a significant difference between the post-test scores in favor of the experimental group. It was concluded that the mathematics education program supported by stories effectively improved children's mathematics skills.

Keywords: Early Childhood Education, Preschool Education, Early Math, Child.

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INTRODUCTION

Mathematics is part of everyday life. Human beings are intertwined with mathematics concerning many experiences in every stage of their life. Every individual needs mathematics for different reasons. Children informally use mathematics to arrange their environment, daily life skills, and games (Moomaw, 2011). Mathematics, a part of daily life, takes place in children's games, stories, and many other areas. Children who use their mathematical skills in their stories and games enjoy what they do (Ginsburg, Greenes & Balfanz, 2003; Jackman, 2005).

Early childhood, where development and learning are high-speed, is especially crucial in developing mathematical concepts and skills. The foundations of the knowledge, skills, and experiences that children will use in their future life are laid in early childhood. The first concepts and skills are acquired through experiences resulting from the child's relationship with objects depending on their perceptual development (Erdoğan, 2005). Encountering mathematical concepts in daily life, and gaining experience starting from the first years of life, are essential in laying mathematics foundations. In early childhood, active learning environments and methods are needed to acquire mathematical concepts and skills (Güven, 2000; Metin, 1997; Wortham, 1998). Interactions with rich, stimulating environments and quality materials and receiving a qualified education contribute significantly to developing mathematical skills (Uyanık & Kandir, 2010). Many studies reported the positive effects of providing active learning environments and different learning experiences to children in their daily life, especially with family support (Anders et al., 2012; Blevins-Knabe & Mussen-Miller, 1996; Manolitsis, Georgioub & Tziraki, 2013).

Today, mathematics-related thinking skills such as mathematical thinking, problem-solving, and reasoning, which are among the 21st- century skills, are at the top of the list; this increases the importance of mathematics even more. In this sense, considering the future professions, mathematics is seen as an area where all individuals in society should improve themselves (Dağlıoğlu, 2020). Early childhood is the period that children begin to acquire many skills and concepts that they will use in the future. Number skills, one of the early learning skills, affect the perception of the mathematical concepts that children will encounter. Children can use these perceived concepts to solve many problems in various areas (Orçan, 2009). These concepts will facilitate their work in mathematics-related tasks they encounter in daily life (Fisher, 1990). Children develop their cognitive processes with mathematical concepts such as counting, shapes, space, time, and measurements (Dinçer & Ulutaş, 1999). In this process, children get the opportunity of thinking, problem-solving, exploring and learning (Aktaş, 2002; Erdoğan, 2006; Yıldız, 2002). For this reason, mathematics education should be started from an early age.

In today's international level exams, children's problems in the field of mathematics are notable. The inadequacy of mathematics education given at early ages is mentioned as the reason for this (Kandir & Orçan, 2010). For children to be more successful in their academic life at later ages, they should receive mathematics education starting from early childhood (Platas, 2008).

Mathematics, which is intertwined with life in early childhood years, becomes a fearful dream in the child's life in the following years. The children's relationship with the mathematics that starts naturally may turn into anxiety and fear later on. Too much focus on the abstract meaning of mathematics, the failure to understand its function in daily life, where and how to use mathematics, and why to learn it, are the issues that negatively affect mathematics learning. In addition, negative experiences related to mathematics, high academic expectations from the child, and the pressure arising from this overshadow the fun aspect of mathematics. Therefore, game-based, funny, and creative activities should be organized for children starting from an early age (Uludağ, 2019).

Mathematics education to be given to children in early childhood should not be based on the direct knowledge transfer but based on learning by discovering, doing, and experiencing knowledge (Aktaş Arnas, 2019; Dağlıoğlu, 2020). Providing high-quality learning opportunities to the child in early childhood, creating enthusiasm for learning mathematics, making the child love mathematics,

and placing the cornerstones of mathematics in the child's mind correctly and effectively have vital importance for the child's mathematics achievement in the future life.

NAEYC and NCTM emphasize the importance of integrating mathematics with other disciplines and activities (NAEYC and NCTM, 2002). Integrating mathematics with other disciplines allows children to use mathematics more actively by establishing a relationship between their own lives and mathematics (Maricic, Stakic & Jovanovic, 2017). In this context, offering the mathematics achievements and indicators in the pre-school education program by integrating them with different activities will effectively support children's mathematics skills. For example, the books, story cards, and puppets used in Turkish-language activities offer teachers an opportunity to present mathematics content and standards. In addition, teachers will support children to gain mathematical standards through the questions generated with them in the pre-story, story-reading, and post-story stages (Turupçu Doğan, 2020).

From an early age, children's correct use of language can be encouraged by supporting mathematics learning. Turkish-language activities used as a teaching method in pre-school education institutions can contribute to children learning of many mathematical concepts. Many mathematical concepts are included in the rhymes, finger games, poems, songs, anecdotes, riddles, and stories used within the scope of Turkish-language activities. For example, language activities such as "five fingers on my right hand" and "twinkle twinkle little star" songs, "one, two three: it is hard to say" rhyme and the story of "seven stupid fishermen" involve many mathematical concepts. Teachers' intended use of such language activities may facilitate children's acquisition of mathematical concepts and enable them to learn with pleasure without fear. Learning mathematics with pleasure and fun can naturally eliminate prejudices and anxieties that hinder mathematics (Taşkın & Tuğrul 2014).

This study was carried out to examine the effect of mathematics education supported by stories on the early mathematics skills of pre-school children. There are very few studies on using stories in early childhood mathematics education (Taşkın & Tuğrul, 2014; Sertsöz & Temur, 2017). Meanwhile, the instruction of mathematical concepts and skills in early childhood entertainingly, with stories and activities in which mathematical language is used, may be effective in developing positive attitudes towards mathematics in later years. The study aimed to reveal the relationship between the stories included within the scope of pre-school children's Turkish-language activities and their development of mathematical concepts. The aim was to investigate the effectiveness of the Mathematics Education Program Supported by Stories on developing mathematics skills of 48-60-month-old children attending pre-school education, and the following questions were addressed:

1. Is there a significant difference between TEMA-3pre-test scores of 48–60-month-old children in the experimental and control group?
2. Is there a significant difference between TEMA-3post-test scores of 48–60-month-old children in the experimental and control group?
3. Is there a significant difference between TEMA-3pre-test and post-test scores of the children in the experimental group who were instructed using the "Mathematics Education Program Supported by Stories"?
4. Is there a significant difference between the TEMA-3pre-test and post-test scores of control group children, instructed according to the current program?
5. What are the adjusted post-test scores of the control group and the experimental group?

METHOD

This study was planned to examine the effect of the mathematics education program supported by stories on the mathematics skills of 48-60-month-old children attending pre-school education.

In this study, the experimental model, one of the quantitative research methods, was used. Experimental models are research models in which data to be observed are generated under the researcher's control to determine cause-effect relationships (Karasar, 1999). The studies with the highest scientific value are those employing true experiments models. The pretest-posttest with a control group model, which is one of the true experimental models, was used in the study. In this model, there are two groups formed by random assignment. One of them is used as the experimental group and the other as the control group. In both groups, pre-experimental and post-experimental measurements are made. The iconic view of the model is as follows Table 1:

Table 1. Pretest – posttest control group model

G1	R	Pre1.1	X	Post1.2
G2	R	Pre 2.1		Post2.2

G1: Experimental group **G2:** Control group **R:** Randomness

X: Mathematics Education Program Supported by Stories (independent variable)

Pre1.1, Pre2.1: Pre-test measurement of groups

Post1.2, Post2.2: Posttest measurement of groups

As seen in the model, experimental and control groups were formed randomly, and the pre-test was administered. Afterward, the mathematics education program supported by stories was instructed to the experimental group. Meanwhile, the control group's program remained unchanged; they continued to receive conventional pre-school education. At the end of the implementation, a post-test was administered to both groups.

Study Group

The study group consisted of 33 children of 48-60-month-old, attending an independent kindergarten affiliated to the Ministry of National Education in the central district of Usak province in the 2020-2021 academic year. The following factors were considered in the school selection: The classrooms having similar socio-cultural characteristics, being educated in the same school, being in the first year of pre-school education, and starting school at the beginning of the academic year. The study was carried out in two classes with 48–60-month-old children. Classes were randomly assigned, one as the experimental group and the other as the control group. The convenient sampling method, one of the non-random sampling methods, was used in the sample selection. It is one of the sampling types commonly used in experimental studies in social sciences, where the researcher selects easy-to-reach and volunteer participants suitable for the research (Stangor, 2014). A total of 33 children were included in the study, 18 in the experimental and 15 in the control group.

Frequency analysis was conducted to see the demographic characteristics of the participants. The gender distribution of the control group is given in Table 2.

Table 2. Gender Distribution of the Control Group

Variable	Group	N	%
Gender	Male	4	26.7
	Female	11	73.3
	Overall	15	100.0

Regarding Table 2, the majority (73.3%) of the participants in the control group are female; 11 of the participants are girls, and 4 are boys.

The gender distribution of the experimental group is given in Table 3.

Table 3. Gender Distribution of the Experimental Group

Variable	Group	N	%
Gender	Male	11	61.1
	Female	7	38.9
	Overall	18	100.0

Regarding Table 3, the majority (61.1%) of the participants in the control group are male; 11 of the participants are boys, and 4 are girls.

Data Collection Tools

The study data were collected using the General Information Form and the Test of Early Mathematics Ability -3 (TEMA-3) Form A.

General Information Form

The general information form developed by the researcher includes the following questions: gender of the child, attendance to a pre-school education institution before, parents' age, education, and income, mother's working status, parents' frequency of reading a book to their child and playing with them.

Test of Early Mathematics Ability -3 (TEMA-3)

Ginsburg and Barody developed TEMA in 1983 to assess children's mathematical abilities. This test covers children between 3-year-old and 8-year-and-eleven-month-old. The test was revised in 1990 and published as TEMA-2. It was revised again in 1993 and stated to be used as TEMA-3. The objective of revising TEMA-2 was to increase the insufficient number of items for early childhood children and make the test easier to understand. Studies in mathematics education have reported that arithmetic and counting skills should be given to children before learning to count with objects (Ginsburg & Barody, 2003). Erdoğan and Baran (2006) adapted the test to Turkish for 60-72-month-old children, and Seker (2013) for 48-60-month-old children, demonstrating that TEMA-3 is a valid and reliable test.

TEMA-3 consists of two separate forms, A and B. These two forms show similarities in measuring children's mathematical abilities. The test consists of seventy-two questions in total. It measures "more or less" and "counting" concepts from informal mathematics fields and "numbers," "relations between numbers," "addition-subtraction," and "decimal" concepts from formal mathematics fields. Ginsburg and Barody (2003) recommended using the forms as pretest and posttest in experimental studies (Erdoğan & Baran, 2006).

The application booklet, including pictures and mathematical symbols, and countable small objects (coins and cubes), are used to administer the TEMA-3 test. The environment in which the test will be administered should be quiet so that the child will not be distracted. The test is applied to children individually; first, the child's chronological age is calculated, and then the test starts with the question corresponding to the child's age. The items to be started for various age groups are as follows:

- From the 1st item for children between 36-48 months,
- From the 7th item for children between 48-60 months,
- From the 15th item for children between 60-72 months,
- From the 22nd item for children between 72-84 months,
- From the 32nd item for children between 84-96 months,

- From the 43rd item for children between 96-107 months.

The test is terminated when the child makes five mistakes in a row. According to the scale manual, questions for younger age groups are accepted as correct, and 1 point is given for each question that children answer correctly. In the end, the points are summed up, and the raw score of the test is calculated. The application booklet has a table titled "Conversion of Raw Scores to Mathematical Ability Score" to convert the raw score to the "mathematical ability score." The "mathematical ability score," derived from the child's raw score and age, is determined for each child from this table (Seker, 2013). The increase in the child's score indicates an increase in mathematics skills (Ginsburg & Barody 2003).

The Validity and Reliability Study of TEMA-3

Ginsburg and Barody developed TEMA in 1983 to assess the mathematical abilities of between 3-year-old and 8-year-and-eleven-month-old children. It was revised in 1990 and published as TEMA-2. Güven and Oktay (1999) conducted the validity and reliability study of TEMA-2 in Turkey and determined that it is a valid and reliable test. In the validity and reliability study by Ginsburg and Barody (2003), the correlations between the forms were: .82 Form A->Form A, .93 Form B->Form B, and .93 Form A->Form B. The internal consistency coefficient was calculated to measure the reliability of the test, and it was .94 for all groups (Ginsburg & Barody, 2003). The adaptation and validity-reliability study of the test for 60–72-month-old children in Turkey were carried out by Erdoğan and Baran (2006). The criterion validity of TEMA-3 was examined within the scope of the validity study. Mann-Whitney U test was used to see whether there was a significant difference between the teachers' opinions and TEMA-3 scores of the children with low and high mathematical skills, and a significant difference was observed. Test-retest correlation was calculated to test the reliability of the test and evaluate the scale's consistency over time. Accordingly, the test-retest correlations between the groups were as follows: .90 Form A->Form A; .88 Form A->Form B; .90 Form B->Form B, and .90 Form B->Form A ($p < .01$). The internal consistency coefficient was also calculated, and the KR-20 value was .92 for Form A and .93 for Form B. These results show that the test's validity and reliability in measuring the mathematics ability of Turkish children aged 60-72 months are high (Erdoğan & Baran 2006).

In the adaptation process of TEMA-3, Seker (2013) formed a group consisting of three English language experts, a measurement and evaluation expert, a Turkish language expert, and a subject area expert. The formed group translated both forms A and B of TEMA-3. The instruction and all items were translated. Correlation analysis and mean test results performed on the scores of 48–60-month-old children from the TEMA-3 form A and form B were parallel in the TEMA-3 form A, the difficulty indexes of the items varied between 0.44 and 0.85. Activities' difficulties were close to average or below average. Regarding item discrimination indexes related to the activities, they varied between 0.20 and 0.55. There was no item with a negative item discrimination index or with an index less than 0.20. The differentiation of items in the TEMA-3 test was moderate and high (Seker, 2013).

KR-20 coefficient was calculated to determine the reliability of the test. The KR-20 reliability coefficient close to 1.00 indicates high reliability, and close to 0.00 means low reliability. In other words, the high reliability of the test indicates that the error involved in the test scores is low, and the low reliability of the test indicates that the error involved in the test scores is high (Özgüven, 2007). The calculated reliability coefficient should be greater than 0.70, and the reliability coefficient calculated for TEMA-3 was 0.703. TEMA-3 scale, which was adapted into Turkish, is moderately reliable (Seker, 2013).

In this study, the effects of family on the mathematical ability of 60–72-month-old children attending pre-school education were evaluated through TEMA-3 Form A. The findings obtained from the evaluations showed that the scale was applicable. The situation was described from the results of the study.

From this point of view, it was aimed to examine the effect of the mathematics education program supported by stories on the mathematics skills of 48-60-month-old children. Children's mathematical skills were measured using TEMA-3 Form A as the pre-test and post-test.

Mathematics Education Program Supported by Stories

"Mathematics Education Program Supported by Stories" has been prepared to support experimental group children's mathematical development. The program integrated the stories in which mathematical concepts are included with language and play activities. The objective is to make children participate actively in the program and learn while having fun.



According to the story; 'A small green inchworm is proud of his skill at measuring anything: a robin's tail, a flamingo's neck, a toucan's beak. Children enjoy the clever inchworm's solution and finding the tiny hero on every page.' Discussion of the story in a follow-up activity children participate the play-math integrated activities.

Picture 1. Activity Example

In the preparation phase of the program, first, a literature review was conducted on mathematics education in early childhood and the development of mathematical concepts. Early childhood mathematics concepts and skills were identified, i.e., numbers and operations, shapes, measurement, matching, grouping, comparison, ordering, pattern, spatial relations, graphics, and probability. These concepts and skills have been studied in detail. Then, the stories containing mathematical concepts and words were searched. The stories included in the program were selected from different materials, such as picture books, written text, and audio stories in digital media. The process was designed as an interactive process in which different techniques are used instead of an ordinary reading.

Based on the stories selected for the education program, educational activities were arranged as Turkish-language, game, and family participation activities in line with the mathematical achievements and indicators of the pre-school curriculum's cognitive part. In this process, materials suitable for educational activities were prepared. The program was planned for 8 weeks and included a total of 24 activities. The development processes of early childhood mathematics skills were taken as the basis in outlining activities by weeks. The children in the experimental group were read stories three days a week (Monday, Wednesday, and Friday), and the program was implemented by integrating stories with activities. The principles of progressing from simple to complex, from concrete to abstract, were followed while preparing the Mathematics Education Program Supported by Stories; Children's individual and developmental differences were considered.

24 educational activities prepared with learning outcomes and indicators in the Mathematics Education Program Supported by Stories were submitted for an expert opinion. The field expert examined the concepts, achievements, and educational status, and necessary revisions were made.

Data collection

Ethics Committee Report that the methods to be applied within the scope of the research are ethically appropriate was granted before starting the study's data collection. Afterward, official permission to conduct the research was obtained from the Usak Provincial Directorate of National Education. Then, the independent kindergarten, where the research would be conducted, was selected.

Before implementing the "Mathematics Education Program Supported by Stories," a short informative meeting was held with the families of the children in the experimental group, and they were informed about the study. At the meeting, the subject and purpose of the study were mentioned, and they were asked to send the children to school regularly and support them at home with family activities. Families filled the Informed Consent Form, allowing their children to participate in the study.

The study was conducted during the second semester of the 2020-2021 academic year. It was carried out in two separate classrooms in an independent kindergarten in the central district of Usak province, affiliated with the Ministry of National Education. The activities of the mathematics education program supported by stories were planned to be performed face-to-face.

Administration of the Pretest

Firstly, the pre-test data were collected from the children in the experimental and control groups in the data collection process. Pre-test data was collected by the researcher between March 1-26, 2021, using TEMA-3. The researcher administered the measurement tool by interviewing the child in a quiet room at the school. The test was not carried out during an activity enjoyed by the children. Before administering the test, a short introduction was given, and a conversation with the child was made, allowing the child to feel comfortable. Before the interview, the researcher explained to the child that she would ask some questions, that it does not matter whether the answer is right or wrong and that what matters is what the child thinks. During the interview, the instructions in TEMA-3 were followed in the order of the assessment tool. The researcher repeated the instructions that the child did not understand, and the expressions that may include clues were avoided. For each instruction, the materials specified in the assessment tool were used. The answers given by the children were recorded in the scoring key. It took an average of 20 minutes to administer the Early Mathematics Ability Test to each child.

Implementation of the Mathematics Education Program Supported by Stories

After completing the pre-tests, the researcher instructed the Mathematics Education Program Supported by Stories in the experimental group 3 days a week (Monday-Wednesday-Friday) for 8 weeks between March 29-May 21, 2021. Each week, a different mathematical concept was discussed, and these concepts were taught to children through story activities; concepts are included in the program as a tool, not the objective. Meanwhile, the children in the control group continued their programs in line with the MoNE 2013 Pre-School Education Program. Mathematics Education Program Supported by Stories activities took place in the classroom and during the daily education flow. Attention was paid to masks and hygiene, and social distance rules were followed.

Administration of the Post-test

After completing the Mathematics Education Program Supported by Stories, TEMA-3 Form A was administered to the children in the experimental and control groups as the post-test between May 24 and June 4, 2020. It was carried out in individual interviews, as in the pre-test.

Data Analysis

A statistics program was used to analyze the data obtained by TEMA-3. Percentage and frequency distributions of the participants were tabulated, and the analysis of the data was performed using parametric and non-parametric statistics as follows: The study was carried out with 33 children of 48-60-month-old. Independent groups t-test was performed to see whether there is a significant difference between pre-test achievement scores that the children in the experimental and control groups got from TEMA-3. Independent groups t-test was performed to see whether there is a significant difference between post-test achievement scores that the children in the experimental and control groups got from TEMA-3. Dependent groups t-test was performed to determine whether there is a significant difference between the experimental group's pre-test and post-test achievement scores

to which "Mathematics Education Program Supported by Stories" was instructed. Dependent groups t-test was performed to determine whether there is a significant difference between the control group's pre-test and post-test achievement scores to which the current education program was instructed. Analysis of covariance (ANCOVA) was used to measure the significance of the difference in children's early maths skills according to the education program (Mathematics Education Program Supported by Stories vs. MoNE). Descriptive statistics were tabulated for the post-test mean score corrected according to the means of the post-test scores of the children in the study group.

In data analysis, the answers given by the children were scored after completing the administration of TEMA-3. "1" point is given for each correct answer and "0" for incorrect ones. The scores were summed up, and the mathematical ability score corresponding to their chronological age was calculated.

RESULTS

To answer the question of "Is there a significant difference between TEMA-3pre-test scores of 48–60-month-old children in the experimental and control group?", independent groups't-test was performed on the pre-test scores of the experimental and control groups. Analysis results are given in Table 4.

Table 4. Results of Independent Groups T-Test Applied to TEMA-3 Pretest Scores

TEST	GROUP	N	X	SD	t	df	p
Pretest	Control	15	98.6667	10.52661	1.613	31	.117
	Experimental	18	91.8889	13.11886	1.646	30.969	.110

Regarding Table 4, there is no significant difference between the groups according to the t-test results, $p > 0.05$. The mean score of the pre-test was ($\bar{X} = 98.66$) for the experimental group and ($\bar{X} = 91.88$) for the control group.

To answer the question of "Is there a significant difference between TEMA-3post-test scores of the experimental and control group?", independent groups't-test was performed on the post-test scores of the experimental group, to which Mathematics Education Program Supported by Stories was instructed, and the control group. Analysis results are given in Table 5.

Table 5. Results of Independent Groups T-Test Applied to TEMA-3 Posttest Scores

TEST	GROUP	N	X	SD	t	df	p
Posttest	Control	15	102.0667	11.36075	-.840	31	.407
	Experimental	18	114.8333	7.44588	-.809	23.353	.426

According to Table 5, the TEMA-3 post-test scores of the experimental and control group students do not differ significantly ($p > 0.05$). Regarding the mean scores, the experimental group's mean ($\bar{X} = 114.83$), in which the Mathematics Education Program Supported by Stories was instructed, is higher than the control group ($\bar{X} = 102.06$). However, this difference was statistically insignificant.

Dependent groups't-test was performed between pre-test and post-test scores of the control group to answer the question of "Is there a significant difference between TEMA-3 pre-test and post-test scores of the children in the control group?" Analysis results are given in Table 6.

Table 6. Dependent Groups T-Test Analysis for the Difference between Control Group Students' TEMA-3 Pretest & Post-Test Scores

CONTROL	N	X	SD	t	df	p
Pretest	15	98.66	10.52661	-2.782	14	.015
Posttest	15	102.06	11.36075			

According to Table 6, there is a significant difference between control group students' TEMA-3 pre-test and post-test scores ($p < 0.05$). This result shows that post-test scores are higher than pre-test scores even though Mathematics Education Program Supported by Stories was not instructed.

To answer the fifth subproblem of the study, "Is there a significant difference between TEMA-3 pre-test and post-test scores of the children in the experimental group who were instructed using "Mathematics Education Program Supported by Stories?", dependent groups' t-test was performed between pre-test and post-test scores of the experimental group. Analysis results are given in Table 7.

Table 7. Dependent Groups T-Test Analysis for the Difference between Experimental Group Students' TEMA-3 Pretest & Post-Test Scores

EXPERIMENTAL	N	X	SD	t	df	p
Pretest	18	91.88	13.11886	-7.374	17	.000
Posttest	18	104.83	7.44588			

According to Table 7, there is a significant difference between experimental group students' TEMA-3 pre-test and post-test scores ($p < 0.05$).

Regarding the participants' mean scores, to whom the Mathematics Education Program Supported by Stories was instructed, their pre-test score is ($\bar{X} = 91.8889$), and the post-test score is ($\bar{X} = 104.8333$). This result can be interpreted as the Mathematics Education Program Supported by Stories implemented on the experimental group is effective in improving children's mathematic skills.

The results of covariance analysis (ANCOVA) performed to measure the significance of the Mathematics Education Program Supported by Stories on participants' early mathematics skills are given in Table 8.

Table 8. Covariance Analysis on the Significance of the Mathematics Education Program Supported by Stories on Participants' Early Mathematics Skills

	Sum of Squares	df	Mean Squares	F	p
Adjusted Model	2052.800 ^a	2	1026.400	40.555	.000
Constant	774.515	1	774.515	30.603	.000
Pre-Test	1990.173	1	1990.173	78.636	.000
Group	400.653	1	400.653	15.831	.000
Error	759.260	30	25.309		
Total	356834.000	33			
Adjusted Total	2812.061	32			

Regarding Table 8, there is a difference between the adjusted scores of the groups. It has been concluded that the Early Mathematics Skills of the children differ according to the method. The difference is due to the higher increase in the score of the experimental group compared to the control group. The high scores of the children in the experimental group show the effect of the implemented education program. The use of the Mathematics Education Program Supported by Stories positively affected participants' early mathematics skills.

Descriptive statistics of the control and experimental groups' post-test scores are given in Table 9.

Table 9. Descriptive Statistics

Group	Mean	Standard Deviation	N
Control	102.0667	11.36075	15
Experimental	114.8333	7.44588	18

Regarding adjusted post-test scores of the experimental and control groups in Table 9, the experimental group's mean is higher than the control group.

DISCUSSION

The study group consisted of 33 children of 48-60-month-old, attending pre-school in an independent kindergarten with a medium socioeconomic level. 18 children were set as the experimental group and 15 as the control group. In this experimental study, the Test of Early Mathematics Ability -3 (TEMA-3) was employed to measure children's mathematical skills. TEMA-3 was administered two times as pre-test and post-test. The obtained data were evaluated with appropriate statistical analyzes, and the following results were obtained.

Pre-test findings of the study showed no significant difference between the TEMA-3 scores of the experimental and control groups ($p>0.05$), and they are close to each other. This finding supports that the children in the experimental and control groups were equivalent in early maths skills at the beginning of the education program. This finding can be interpreted as the study is appropriate in terms of the experimental method.

There is a significant difference between the pre-test and post-test scores of the children in the experimental group who were instructed using the mathematics education program supported by stories ($p<0.05$). This difference is also seen in the control group who continued their education with the current program ($p<0.05$). Regarding the pretest-posttest scores of the experimental and control groups, a significant increase is observed in the post-test scores of both groups. In this case, it can be said that both the Mathematics Education Program Supported by Stories and the existing pre-school education program had a positive effect on improving children's mathematics skills. However, although there is an achievement on the control group, who continued education with the current pre-school education program, the experimental group's achievement was higher.

From this point of view, we can say that the Mathematics Education Program Supported by Stories instructed on the experimental group is more effective in improving children's mathematical ability. Burton (2001) showed that stories positively affect children's number development; therefore, they could be used at every stage of mathematics education, which supports the current study's findings.

In the study, adjusted means of the post-test scores showed that the experimental group's mean score was higher than the control group. Accordingly, mathematics education supported with stories was more effective than the traditional method in improving children's mathematical skills. This result is in parallel with the studies of Akdemir (2018), Aksoy (2010), Coşkun (2013), Sertsöz (2017), Ünüvar (2019), Yaralı (2019) and Yıldırım (2018) and supports the findings of the research. Especially storybooks offer rich opportunities for children to learn basic mathematics concepts. Although language activities do not directly involve mathematical concepts, they increase children's overall academic and mathematical achievement (Koç et al., 2002). In his study, Dur (2010) showed that students who are highly successful in language could use more mathematical relations and conceptual features, more mathematical concepts, and their mathematics language usage skills are high. Thus, it is crucial to use stories in mathematics activities because children's language achievement positively affects their success in mathematics and increases their reading comprehension skills.

Greenes, Ginsburg and Balfanz (2004) revealed that children's use of mathematical language increases by reading stories rich in mathematical language, and their expressive language becomes strong. From this point of view, study results imply that the use of stories in mathematics education also contributes to the development of mathematical language in children.

Covariance analysis was performed to measure the significance of the change in children's Early Mathematics Skills after the instruction of the "Mathematics Education Program Supported by

Stories." Early Mathematics Skills of the children were found to differ according to the method. The use of the Mathematics Education Program Supported by Stories positively affected children's early mathematics skills. Katipoğlu (2019) examined the effects of "mathematics instruction through storytelling" on the mathematics achievement of 5th-grade students. The results showed that instruction through stories is more effective than the traditional method in reducing students' math anxiety and fear of math and making them love math. After the implementation, the experimental group students' opinions about instruction through stories had been taken. Students said that; the lessons were fun, and they liked the lessons more, complicated subjects became more straightforward and more understandable, the learning was enjoyable and permanent, and they developed positive feelings towards the teacher. So, it can be said that the use of stories in mathematics education lets the children learn mathematics in a more fun way and make them love mathematics.

CONCLUSION

Children are natural storytellers when they are left on their own. They use this natural storytelling in both mathematics and other learning areas. This study revealed that stories could support the mathematics skills of 48-60-month-old children. Supporting children's use of storytelling in mathematics is a requirement for children's development. Giving importance to stories in education enables children to make inferences from what they have learned, reflect their knowledge, and use their intelligence freely (Arslan Başdağ & Dağlıoğlu, 2020; Burton, 2001).

The nursery rhymes and songs involving numbers that children sing in games, conversations, daily activities, and the stories they listen to are significant in developing children's sense of numbers (NAEYC & NCTM, 2002). Integrating mathematical concepts with stories creates a funny and enjoyable environment for the child, and children are introduced to mathematical concepts. During early childhood process it is crucial use stories in mathematics activities because children's language achievement positively affects their success in mathematics and increases their reading comprehension skills.

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