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EFED, 2020; 12(2): 49-59 **Araştırma Makalesi**

The Effect of Montessori Materials Supported Mathematics Instruction on Early Mathematical Reasoning Skills[1]

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Abstract: It is known that the preschool period is a critical period in the development of mathematical reasoning skills. Preschool curriculums which are implemented to support the development of these skills in the early period has a great importance. Considering that mathematical reasoning includes notional concepts for preschool children, it can be thought that Montessori Method, which works with concrete materials in the instructional process, will be effective for the development of related skills. The aim of this study is to analyze the impact of mathematics instruction supported with Montessori materials on early mathematical reasoning skills. In this experimental study, pre and post-test control group design was applied. It is carried out on 30 preschool kids, 15 of whom are involved in experimental group and 15 of whom are involved in the control group. This implementation is carried out with the mathematics instruction supported with Montessori materials in the experimental group, and the mathematics instruction based on Preschool Curriculum (2013) in the control group. "Evaluation Tool of Early Mathematical Reasoning Skills" was used as a pre and posttest, and the data was collected by Mann Whitney U Test considering gender and reasoning skills variants. In the data obtained, there was a significant correlation between the performance of the kids' mathematical reasoning skills in the experimental and control group in favour of experimental group. Besides, it is observed that there was not any correlation between the performance of the kids' early mathematical reasoning skills in the control and experimental group based on the gender variant.

Keywords:
Montessori method,
Early mathematical skills,
Reasoning, Gender,
Preschool education

Montessori Materyalleri Destekli Matematik Öğretiminin Erken Matematiksel Akıl Yürütme Becerilerine Etkisi

Öz: Okul öncesi dönemin matematiksel akıl yürütme becerilerinin gelişiminde kritik bir dönem olduğu bilinmektedir. Erken dönemde bu becerilerin gelişimini desteklemek için uygulanan eğitim programları büyük önem taşımaktadır. Matematiksel akıl yürütmenin okul öncesi dönem çocukları için soyut kavramları içerdiği düşünüldüğünde, öğretim sürecinde somut materyallerle çalışan Montessori Metodu'nun ilgili becerilerin gelişimi için etkili olacağı düşünülebilir. Çalışmanın amacı, Montessori materyalleri destekli matematik öğretiminin erken matematiksel akıl yürütme becerilerine etkisini incelemektir. Araştırmanın çalışma grubunu okul öncesi eğitime devam eden deney grubunda 15, kontrol grubunda 15 olmak üzere toplam 30 çocuk oluşturmuştur. Uygulama, deney grubunda Montessori materyalleri destekli matematik öğretimi ile kontrol grubunda MEB (2013) Okul Öncesi Eğitim Programı destekli matematik öğretimi ile sürdürülmüştür. Ön test ve son test olarak 'Erken Matematiksel Akıl Yürütme Becerileri Değerlendirme Aracı' uygulanmış, veriler cinsiyet ve akıl yürütme değişkenlerine ilişkin Mann Whitney U testiyle analiz edilmiştir. Elde edilen bulgularda deney ve kontrol grubunu oluşturan çocukların matematiksel akıl yürütme becerileri arasında deney grubu lehine istatistiksel olarak anlamlı bir fark olduğu görülmüştür. Ek olarak deney ve kontrol grubu çocuklarının erken matematiksel akıl yürütme becerilerinde cinsiyete göre anlamlı bir fark göstermediği görülmüştür.

Anahtar Sözcükler:
Montessori metodu,
Erken matematiksel beceriler,
Akıl yürütme, Cinsiyet,
Okul öncesi eğitim

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INTRODUCTION

Basic knowledge and skills gained from qualified and sufficient experiences at an early age not only increase the child's chance of success in later learning, but also positively affect his emotional and social life (Yildiz, 1998). Preschool education, which is a part of formal education, covers the period from the day the child is born to the beginning of primary education and plays an important role in the later learning stages. Duffy (1998) emphasizes the importance of preschool education by stating that eighty percent of human development is completed in these years. When the literature is examined, it is seen that preschool period is an important process that affects all developmental areas of the child. In this phase, where all areas of development are active, the acquisition of thinking, commenting and problem-solving skills enable the child to progress by laying solid foundations in the next process (Aral et al., 2000; Gurkan, 2008). While examining the thinking and decision making process of the children, examining the ways used while thinking and how they have been reached, which can be equivalent to the time spent in this process, can provide more qualified comments about the stage of development of children. One of the ways to interpret children's thoughts is to examine their reasoning skills (Kurtz et al., 1999; Guven, 2000; Unutkan, 2007).

The development process of reasoning skills of children occurs when they realize the situations they encounter while solving any problem and analyze how these situations help them when they come to a conclusion. Sperry Smith (2016) emphasized the importance of analyzing the mathematical relationships of reasoning skills such as classification, comparison, matching and ordering, emphasizing the need to understand the foundations of early mathematics and underlined that the fundamental lack of knowledge may lead children to rote learning such as counting, writing numbers and finding the correct number of objects.

The development process of reasoning skills in children occurs when they realize the situations they encounter while solving any problem and analyze how these situations help them when they come to a conclusion. The ways in which children access information in this process and why they prefer these paths can be determined by the teacher. Learning materials that develop reasoning skills in preschool period have an important place to increase the effectiveness of learning in mathematics as well as in different fields such as language development, psychomotor development, and social-emotional development (Umay, 2007; Kol, 2011; Yesilyurt, 2011). Failure of the child to develop his reasoning skills adequately in preschool period causes his life to be biased towards mathematics activities and not to reach the level he desires in his academic success. For this reason, the use of different teaching methods can be effective in developing the reasoning skills that are tried to be acquired with math activities and making education more meaningful and permanent.

The 'Preschool Education Program for Children 36-72 Months', which is used in preschool education, was updated with the development studies in 2012-2013 within the scope of national and international field researches and incoming feedbacks. This program was formed in a developmental spiral and eclectic structure by taking into consideration the developmental characteristics of children, their desire for interest and environmental conditions, in order to ensure that children attending preschool education institutions get healthy growth through their rich learning experiences, support all areas of development, acquire self-care skills and be ready for primary education (Ministry of National Education, 2013).

Gulkanat (2015) states that the constructivist education approach is adopted in the education system in Turkey, but this educational approach does not reveal the creativity, talents and skills of the child correctly. In this context, she states that pre-school education institutions tend towards alternative education methods. One of the alternative training methods widely used today is the Montessori Method. Maria Montessori, with the help of the materials she prepared in teaching the method, followed the children in their discovery areas and based her method on observation (Cakiroglu-Wilbrandt et al., 2008). Yigit (2008) lists the general objectives of the Montessori Method as the child's positive attitude towards school, showing love for learning, showing self-discipline, being self-motivated, acting independently, enjoying repeating and studying, developing self-confidence, gaining habit of concentration, nurturing permanent curiosity, the development of inner trust and sense of order, choice of studying instead of playing. When the relevant literature is examined, many studies (Pate et al., 2014; Fleming et al., 2019; Denervaud et al., 2020) have been found that support the fact that children are more active in schools where the Montessori Method is applied, and they participate in the education process by correcting their mistakes themselves. Montessori (1963) expresses her method as an educational approach that avoids teacher intervention and advocates leaving alone to experience. Considering the didactic materials of the method, the teacher's task requires active preparation and guidance. Standing (1962) states that the child who comes to the Montessori School will gain a fascinating experience where she can explore from all directions in the environment prepared for her. Through these specially prepared

materials, which are among the remarkable features of the Montessori Method, she states that the teacher will guide her in the discovery paths with sufficient instruction and material support and prepare her for this process. The child is given the opportunity to check his/her own mistake. If the child is unable to see the error himself/herself based on materials, this indicates that the child is not developing enough. The child notices the mistake with the time and goes to the correction, not through teacher intervention (Temel, 1994). According to the method, the most important task of the child in self-development is physical awareness together with coordinated studies (Lillard, 1996). The material specific to the method presented to provide physical awareness has error control mechanism in itself and helps to develop the self-control power of the child (Korkmaz, 2005).

Various studies are encountered in the literature to observe the application stages of the method and the individual changes it provides in children (Basargekar and Lillard, 2021; Cossentino, 2006; Courtier et al., 2021; Duckworth, 2006; Durkaya, 2019; Lillard and Else-Quest, 2006; Siaviki et al., 2021; Yusufovna, 2021). It is seen that the common point of the studies is that the method develops skills such as concentrating attention, concentrating on the job and managing the reasoning process itself with the materials used and the method also focuses the child in the education-training process. With the help of the materials presented, Lillard (2013) argues that children experience their own learning and lay the foundations of logical-mathematical thinking. The child now needs to question his environment, wonder what happened, produce ideas about events, and solve problems. This whole process signals that the child is getting ready for the acquisition of mathematical thinking and reasoning skills. In this context, a teaching method that prioritizes physical awareness can be used in the development of reasoning skills that manifest themselves in preschool education period. The problem statement of the study conducted in this direction was determined as "Does Montessori materials supported mathematics instruction has an effect on the development of early mathematical reasoning skills?" The problem statement of the research was tested with the hypotheses given below.

1. Montessori materials supported mathematics instruction has an impact on the development of early mathematical reasoning skills.
2. The development of early mathematical reasoning skills shows a significant difference by gender in Montessori materials supported mathematics instruction.
3. The development of early mathematical reasoning skills shows a significant difference by gender in MONE (2013) Preschool Education Program supported mathematics instruction.

METHOD

Research Design

Since the effects of Montessori materials supported mathematics instruction on early mathematical reasoning skills were investigated in the study, it was decided to organize it according to the experimental pattern with pretest-posttest control group. Ekiz (2015) defines the experimental design as the research design conducted to determine the cause and effect relationships between the variables by comparing any event, phenomenon and factor and to measure the results by comparing them.

Study Groups

The study group was selected by purposeful sampling. Y Kindergarten was chosen as the experimental group. This group is the group where preschool teachers, who are equipped with the mathematical materials required by the study and who are trained in the implementation of the Montessori Method, are present. As the control group, X Kindergarten were selected in the nearby neighborhood in the same district. X Kindergarten sample group is a class whose average age group is close in months and starts education at the same time. Purposeful sampling is the oriented correlation of case studies systematically and randomly selected for the purpose of the research (Marshall and Rossman, 2014). In the second stage, the children who will form the experimental and control groups were selected by simple random sampling from the schools determined by purposive sampling and the study group was formed. Simple random sampling is done to ensure that the probability of sampling units is equal (Karasar, 2005). In this study, a total of 15 participants, 7 girl and 8 boy, for the experimental group and a total of 15 participants, 7 girl and 8 boy, for the control group were selected randomly.

Equivalency Process

In order to determine whether the experimental and control groups differ in terms of mathematical reasoning skills input behaviors and whether children differ in the relevant skills by gender, Mann Whitney U Test was

applied before the experimental procedure. When the pretest scores of the groups were examined, it was seen that they did not provide superiority to each other.

Data Collection Instrument and Processes

The research data were collected with the 'Evaluation Instrument for the Early Mathematical Reasoning Skills' developed by Ergul (2014). Evaluation Instrument for the Early Mathematical Reasoning Skills: There are a total of 40 questions in the ''Evaluation Instrument for the Early Mathematical Reasoning Skills' developed by Ergul (2014). 21 of the questions are in the measurement area and 19 are in the data analysis-probability area. There are 21 questions in inductive reasoning and 19 questions in deductive reasoning.

Holistic gradual scoring system was preferred in the study due to reasons such as the importance of the process and the small age group in mathematical reasoning studies. In holistic scoring, the work of the individual is evaluated in a holistic way and the level of success of the individual is observed. Expressions that estimate what an individual can do for each level are created in the holistic scoring system. In some cases, a special scoring rubric is used that contains criteria and definitions for a particular situation or task. The scoring key in this format is the task-specific scoring rubric (Kutlu et al., 2010). When examined in accordance with the transferred features, the task-specified holistic rubric developed by Ergul (2014) was used in the study. The comments that children can make regarding the reasons of their answers to the questions are estimated and the criteria are determined in general by considering the process passed regarding scoring rubric. After this stage, the answers of the children were estimated and each question was scored in the range of 0-5 according to the criteria. Information on the data collection process is given in the following title.

Before the implementation and after the four-week implementation process, the 'Evaluation Instrument for the Early Mathematical Reasoning Skills' was applied as pre and posttest to all experimental and control groups in order to determine the development of mathematical reasoning skills.

Studying Processes of the Experimental and Control Groups

After it was understood that the groups' input behaviors were equal, Montessori materials supported mathematics instruction were applied in the experimental group and Ministry of National Education (2013) Preschool Curriculum supported mathematics instruction was applied in the control group by classroom teachers.

In the first stage of the implementation, the mathematical materials used in the Montessori Method prepared and applied by examining the book of Montessori Approach in Preschool Education by Cakiroglu-Wilbrandt (2012) were examined and mutual information was exchanged in the experimental group including the class teacher. During the implementation process, Montessori Method supported mathematics instruction was applied to the children who formed the experimental group by class teachers with Montessori Education. In addition, only the Ministry of National Education (2013) Preschool Curriculum supported mathematics instruction was applied to the control group by their class teacher. After the four-week application period, the 'Evaluation Instrument for the Early Mathematical Reasoning Skills' was applied as a posttest to all experimental and control groups in order to determine the development of mathematical reasoning skills.

Data Analysis

The data obtained from the research were analyzed with the Mann Whitney U test according to the hypotheses of the research.

Validity and Reliability Measures

While creating the questions in the evaluation instrument, Ergul (2014) interviewed nine experts who worked in the field of preschool education and primary mathematics for the validity of the instrument. The preliminary application of the evaluation instrument was made with a working group of 50 people, and the question frequencies and percentages of knowledge were examined after the application. In order to determine whether the questions in the 'Measurement' and 'Data Analysis- Probability' fields in the evaluation instrument are suitable for distinguishing children in terms of the properties measured, item analyzes based on the difference of the group averages of the upper 27% and lower 27% were performed. For the reliability studies of the evaluation instrument, test-retest was performed with 40 children. The test-retest reliability for all areas in the evaluation instrument was found above .98. According to the validity and reliability studies conducted, Ergul (2014) evaluation instrument was finalized.

Ethics Committee Permission Information

This study was approved by Kirklareli University Institute of Health Sciences Ethics Committee on 06.08.2018 (Decision No: 09).

FINDINGS

The findings obtained from the comparison of the posttest scores regarding the mathematical reasoning skills of the experimental and control groups within the scope of the first hypothesis are presented in Table 1.

Table 1.

Mann Whitney U Test Values Regarding Posttest Scores of Experimental and Control Groups.

			Groups	N	M	Total	U	P
MEASUREMENT			Exp 1	15	2,84	20,23	41,5	0,00
			Control	15	2,35	10,77		
			Exp 1	15	2,83	20,10	43,5	0,00
	Induction		Control	15	2,47	10,90		
		Length and Weight	Exp 1	15	3,93	20,10	43,5	0,00
			Control	15	3,19	10,90		
		Field and Volume	Exp 1	15	2,66	20,63	35,5	0,00
			Control	15	2,13	10,37		
		Time Sequencing	Exp 1	15	1,89	14,23	93,5	0,42
			Control	15	2,09	16,77		
			Exp 1	15	2,86	20,07	44,0	0,00
	Deduction		Control	15	2,23	10,93		
		Testing	Exp 1	15	3,33	20,50	37,5	0,00
			Control	15	2,51	10,50		
		Comparison of Verbal	Exp 1	15	2,38	18,47	68,0	0,06
		Problems	Control	15	1,96	12,53		
DATA ANALYSIS – PROBABILITY			Exp 1	15	2,66	19,93	46,0	0,01
			Control	15	2,18	11,07		
			Exp 1	15	3,11	17,97	75,5	0,12
	Induction		Control	15	2,89	13,03		
		Knowing the Features	Exp 1	15	3,91	18,30	70,5	0,08
		of Shapes	Control	15	3,40	12,70		
		Creating Charts	Exp 1	15	2,31	16,53	97,0	0,51
			Control	15	2,38	14,47		
			Exp 1	15	2,21	20,70	34,5	0,00
	Deduction		Control	15	1,47	10,30		
		Image Inspection and	Exp 1	15	2,67	19,10	58,5	0,02
		Prediction of Status	Control	15	2,12	11,90		
		Reading Charts and	Exp 1	15	2,15	18,47	68,0	0,06
		Saying the Results	Control	15	1,76	12,53		
		Specifying Probability	Exp 1	15	1,71	20,87	32,0	0,00
			Control	15	0,54	10,13		
Mathematical Reasoning			Exp 1	15	2,75	20,47	38,0	0,00
			Control	15	2,27	10,53		

When the values of Mann Whitney U Test (U=38,0, p<.05) are examined in Table 1, comparing the performance of mathematical reasoning skills of preschool children who applied Montessori materials supported mathematics instruction and Ministry of National Education (2013) Preschool Curriculum supported mathematics instruction, it is seen that there is a significant difference between them in favor of the experimental group.

While there is a significant difference between the posttest scores of 'measuring and comparing results' (length and weight skill) (U=43,5, p<0.5) and 'measuring and comparing results' (field and volume skill) (U = 35.5, p <0.5) included in the induction dimension of the measurement list, there is no statistically significant difference between the posttest scores related to 'time sequencing skill' (U = 93,5, p> .05). While there is a significant difference between the posttest scores related to 'understanding the accuracy of the results' (testing skill) (U=37,5, p<0.5), there is no significant difference between the posttest scores regarding 'comparison of verbal problems skill' (U=68, 0, p>0.5) in the deduction dimension of the measurement list.

There is no statistically significant difference between the posttest scores of 'knowing the features of shapes' (U=70,5, p>.05) and 'creating charts' (U=97,0, p>.05) skills in the induction dimension of the data analysis-

probability list. While there is a significant difference in the posttest scores regarding 'image inspection and prediction of status' (U=58,5, p<.05), there is no significant difference in the posttest scores regarding 'reading charts and saying the results' (U=68,0, p>.05), and there is a statistically significant difference in the posttest scores regarding 'specifying probability' (U=32,0, p<.05) skills in the deduction dimension of the data analysis-probability list. In the context of the second hypothesis, the findings obtained from the comparison of the posttest scores regarding the mathematical reasoning skills of the experimental group by gender are presented in Table 2.

Table 2.

Mann Whitney U Test Results Regarding Mathematical Reasoning Skills of the Experimental Group by Gender

			Groups	N	M	Total	U	P
MEASUREMENT			Girl	7	2,97	8,79	22,5	0,52
			Boy	8	2,73	7,31		
			Girl	7	3,04	9,00	21,0	0,42
	Induction		Boy	8	2,64	7,13		
		Length and Weight	Girl	7	4,14	8,43	25,0	0,73
			Boy	8	3,75	7,63		
		Field and Volume	Girl	7	2,79	8,00	28,0	1,00
			Boy	8	2,54	8,00		
		Time Sequencing	Girl	7	2,19	10,14	13,0	0,06
			Boy	8	1,63	6,13		
			Girl	7	2,91	8,57	24,0	0,64
	Deduction		Boy	8	2,81	7,50		
		Testing	Girl	7	3,38	8,93	21,5	0,44
			Boy	8	3,29	7,19		
		Comparison of Verbal	Girl	7	2,43	8,50	24,5	0,68
		Problems	Boy	8	2,33	7,56		
DATA ANALYSIS – PROBABILITY			Girl	7	2,97	9,57	17,0	0,20
			Boy	8	2,39	6,63		
			Girl	7	3,43	8,79	22,5	0,52
	Induction		Boy	8	2,83	7,31		
		Knowing the Features	Girl	7	4,00	8,14	27,0	0,91
		of Shapes	Boy	8	3,84	7,88		
		Creating Charts	Girl	7	2,86	9,50	17,5	0,21
			Boy	8	1,83	6,69		
			Girl	7	2,50	9,36	18,5	0,27
	Deduction		Boy	8	1,95	6,81		
		Image Inspection and	Girl	7	2,86	8,21	26,5	0,86
		Prediction of Status	Boy	8	2,50	7,81		
		Reading Charts and	Girl	7	2,72	9,79	15,5	0,14
		Saying the Results	Boy	8	1,83	6,44		
		Specifying Probability	Girl	7	1,93	8,64	23,5	0,60
			Boy	8	1,52	7,44		
Mathematical Reasoning			Girl	7	2,97	8,86	22,0	0,49
			Boy	8	2,56	7,25		

When the values of Mann Whitney U Test (U=22,0, p>.05) are examined in Table 2, comparing the performance of mathematical reasoning skills of preschool children who applied Montessori materials supported mathematics instruction, it is seen that there is no significant difference in the posttest scores in terms of gender.

There is no statistically significant difference between the posttest scores of 'measuring and comparing results' (length and weight skill) (U=25,0, p>.05), 'measuring and comparing results' (field and volume skill) (U = 28.0, p <0.5)' and 'time sequencing skill' (U=13,0, p>.05) in the induction dimension of the measurement list. There is no statistically significant difference between the posttest scores of 'understanding the accuracy of the results' (testing skill) (U=21,5, p>.05) and 'comparison of verbal problems skill' (U=24,5, p>.05) in the deduction dimension of the measurement list.

There is no statistically significant difference between the posttest scores of 'knowing the features of shapes' (U=27,0, p>.05) and 'creating charts' (U=17,5, p>.05) skills in the induction dimension of the data analysis-probability list. There is no statistically significant difference between the posttest scores regarding 'image inspection and prediction of status' (U=26,5, p>.05), 'reading charts and saying the results' (U=15,5, p>.05) and 'specifying probability' (U=23,5, p>.05) skills in the deduction dimension of the data analysis-probability list. In

the context of the third hypothesis, the findings obtained from the comparison of the posttest scores regarding the mathematical reasoning skills of the control group by gender are presented in Table 3.

Table 3.

Mann Whitney U Test Results Regarding Mathematical Reasoning Skills of the Control Group by Gender

			Groups	N	M	Total	U	p
MEASUREMENT			Girl	7	2,32	7,57	25,0	0,73
			Boy	8	2,38	8,38		
			Girl	7	2,49	8,36	25,5	0,77
	Induction		Boy	8	2,45	7,69		
		Length and Weight	Girl	7	3,26	8,21	26,5	0,86
			Boy	8	3,13	7,81		
		Field and Volume	Girl	7	2,21	9,00	21,0	0,41
			Boy	8	2,06	7,13		
		Time Sequencing	Girl	7	2,00	7,21	22,5	0,52
			Boy	8	2,17	8,69		
			Girl	7	2,14	7,07	21,5	0,45
	Deduction		Boy	8	2,31	8,81		
		Testing	Girl	7	2,38	7,00	21,0	0,41
			Boy	8	2,62	8,88		
		Comparison of Verbal	Girl	7	1,90	7,36	23,5	0,59
		Problems	Boy	8	2,00	8,56		
DATA ANALYSIS – PROBABILITY			Girl	7	2,33	10,00	14,0	0,11
			Boy	8	2,05	6,25		
			Girl	7	3,07	10,07	13,5	0,08
	Induction		Boy	8	2,73	6,19		
		Knowing the Features	Girl	7	3,48	8,36	25,5	0,77
		of Shapes	Boy	8	3,33	7,69		
		Creating Charts	Girl	7	2,67	9,86	15,0	0,13
			Boy	8	2,13	6,38		
			Girl	7	1,59	9,00	21,0	0,42
	Deduction		Boy	8	1,37	7,13		
		Image Inspection and	Girl	7	2,18	8,21	26,5	0,86
		Prediction of Status	Boy	8	2,06	7,81		
		Reading Charts and	Girl	7	1,95	9,07	20,5	0,38
		Saying the Results	Boy	8	1,58	7,06		
		Specifying Probability	Girl	7	0,64	9,57	17,0	0,19
			Boy	8	0,46	6,63		
Mathematical Reasoning			Girl	7	2,32	9,00	21,0	0,42
			Boy	8	2,22	7,13		

When the values of Mann Whitney U Test (U=21,0, p>.05) are examined in Table 3, comparing the performance of mathematical reasoning skills of preschool children who applied Ministry of National Education (2013) Preschool Curriculum supported mathematics instruction, it is seen that there is no significant difference in the posttest scores in terms of gender.

There is no statistically significant difference between the posttest scores of 'measuring and comparing results' (length and weight skill) (U=26,5, p>0.5), 'measuring and comparing results' (field and volume skill) (U=21,0, p>0.5) and 'time sequencing skill' (U=22,5, p>0.5) in the induction dimension of the measurement list. There is no statistically significant difference between the posttest scores of 'understanding the accuracy of the results' (testing skill) (U=21,0, p>0.5) and 'comparison of verbal problems skill' (U=23,5, p>0.5) in the deduction dimension of the measurement list.

There is no statistically significant difference between the posttest scores of 'knowing the features of shapes' (U=25,5, p>.05) and 'creating charts' (U=15,0, p>.05) skills in the induction dimension of the data analysis-probability list. There is no statistically significant difference between the posttest scores regarding 'image inspection and prediction of status' (U=26,5, p>.05), 'reading charts and saying the results' (U=20,5, p>.05) and 'specifying probability' (U=17,0, p>.05) skills in the deduction dimension of the data analysis-probability list.

CONCLUSION AND DISCUSSION

It is seen that the research findings support the first hypothesis of the research, which was founded as "Montessori materials supported mathematics instruction has an impact on the development of early mathematical reasoning skills."

As a reason for the meaningful improvement in the testing skill, which is included in the deductive dimension in the measurement list, can be seen as child's desire for discovery, thinking about the situation with the possibilities and learning to test the solutions that will be correct at the end of this process. Lillard (2013) supports the research findings, arguing that the materials in the Montessori class include both direct and indirect concept acquisitions and that children act entirely with their own interests, desires and orientations when working with these materials. Faryadi (2017), in her study examining the mathematical competencies in preschool children, revealed that the group that applied the Montessori Method was at a higher level in critical thinking and problem solving skills. The results of the study support the research findings. The fact that Uyanik and Kandir (2010) stated that the child who is often confronted with stimulating materials in the preschool period, and that the child interacts with these materials in a qualified way will lead a quality education process and that these skills will be supported because they experience mathematical experiences as a result of the process, supports the research findings.

The reason for not having a significant improvement in the skill of comparing verbal problems can be seen as the children who are intensely interested in individual studies can communicate with their classmates for a limited time. Sak (2014), in his study on teacher evaluations regarding Montessori and Regio Emilia approaches, revealed that teachers concentrate on the limited number of large group activities under the heading of 'Negative aspects of the Montessori Method'. The teachers stated that the low number of large group activities would cause problems for the social development of the child and that these activities were important for the acquisition of skills such as perceiving verbal expressions, expressing themselves verbally, understanding, sharing and helping. The results support these research findings. Eliason and Jenkins (2003) conducted interviews with preschool teachers in their studies and found that teachers argued that it is not sufficient for learning to show the subjects that require mathematical reasoning in literacy or worksheets. The teachers state that the activities that children do by staying still, quiet and calm in this process restrict their curiosity and excitement about the subject. For this reason, they suggest that the concepts related to mathematics should be made concrete by using daily experiences and materials. This study supports the research findings. Erdogan and Baran (2003) stated in their study by arguing that children will perceive the concepts as long as they can observe, touch, taste and hear; and that the Mathematics Curriculum to be developed should consist of experiences that will increase the expressive characteristics of children and that will enable them to develop new experiences. Aydogan (2007) in her study examined whether the "Concept Education Program" prepared in accordance with the method of Piaget and Montessori was effective in the acquisition of geometric shape and number concepts of 6-year-old children. In contrast to these research findings, the results obtained from the study showed that there was a significant improvement in favor of the experimental group in recognizing and distinguishing the shapes. These findings support the findings of this research.

The main reason for the lack of a meaningful improvement in the ability to know the characteristics of the figures in the induction dimension of data analysis - probability list and to create graphics can be shown as the limited number of materials that will represent these concepts in the Montessori materials in the classroom. Asfuroglu (1990) in her study examined the education applied in order to gain the concepts of triangle, circle and square in preschool period in two groups, with and without material support. As a result of the study, it was seen that the group receiving material-supported training showed a significant difference in recognizing square, triangular and circle shapes to the group receiving training without material support. It is seen that the study results do not support these research findings. Laski et al. (2016) supported the research findings by determining that not all materials of the Montessori Method are equally effective in the arithmetic thinking and strategy use skills of primary school children.

It is seen that the research findings do not support the second hypothesis of the study, "The development of early mathematical reasoning skills shows a significant difference by gender in Montessori materials supported mathematics instruction." In the study of Beken (2009) investigating the effects of the Montessori Method in the drawing and painting skills of 5-6 year-old children, no significant difference was found between girls and boys in terms of gender at the end of the applications made with the Montessori Method. These findings support the fact that the research does not show a significant difference by gender in studies where manual skills such as measuring and comparing the results, knowing the features of the shapes, and creating graphics are prominent with non-standard units. In the study of Seker (2015), comparing the motor skills of 5-year-old children who are continuing their education in rural areas and 5-year-old children with Montessori Method education, it was found that there is no significant difference in the motor development of boys and girls trained with the Montessori Method. According to the research, no meaningful development was observed by gender among children who supported the development of manual skills by using materials. In a similar study

conducted at different instruction levels, Becker (1990) used national standards tests based on mathematical reasoning, identified four subject areas: algebra, arithmetic, geometry and mixed section; and identified two types of items: multiple choice and data competence. The result of this research showed that, contrary to the preschool studies; a significant difference emerged by gender. When the gender differences in students' subject field and item types were examined, it was found that girls had difficulties in the field of algebra and boys had difficulties in the section with mixed questions.

It is seen that the research findings do not support the third hypothesis of the study, which states that "The development of early mathematical reasoning skills shows a significant difference by gender in Ministry of National Education (2013) Preschool Curriculum supported mathematics instruction." Karakus and Akman (2016) in their study examined the mathematics concepts and achievements of children aged 2-6 by gender and some variables. It was observed that the mean scores of other subtests other than the number and size subtests of mathematics concepts and achievements and the mean scores of the tests related to mathematics did not show a significant difference by gender of the children. The results of the study support the findings of this research. Ergul (2014), in her study where she developed the 'Evaluation Instrument for the Early Mathematical Reasoning Skills', supports the findings of this research again that preschool children do not show a significant difference by gender in terms of mathematical reasoning skills. In many studies that examine math skills in terms of gender variable in preschool period, the finding that gender is not an effective variable on related skills is in line with the findings of this research (Beller and Gafni, 1996; Ayvaz, 2014).

Considering the results of the research, seminars can be expanded by determining the preschool development characteristics in Montessori Method supported mathematics instruction that will be developed in line with the opinions of the existing program. Educators' access to materials that will improve the mathematical reasoning skills used in the Montessori Method should be facilitated. In order to increase the performance of the preschool child's reasoning skills, the effects of the activities to be prepared not only in the field of mathematics; but also in the fields of grammar, science, drama, and games can be investigated. It is observed that in studies where mathematical reasoning skills are examined in the literature, mostly studied with older age group. Considering that the preschool period is the first step in terms of child development, it can be suggested to increase the number of studies with the young age group regarding mathematical reasoning skills.

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