Article History
Received: 13.07.2023
Received in revised form: 21.11.2023
Accepted: 06.12.2023
Article Type: Research Article

International Journal of Contemporary Educational Research (IJCER)

www.ijcer.net

The Effect of the Montessori Method Integrated with Collaborative Learning on Early Mathematical Reasoning Skills

Kardelen Ön Hallumoğlu[1], H. Gülhan Orhan Karsak[2], Ayse Fulya Maner [3]
[1] Ministry of National Education, 0000-0002-8655-0155
[2] Kırklareli University, 0000-0001-5927-6341
[3] Kırklareli University, 0000-0003-1429-9333

To cite this article:

Ön Hallumoğlu, K., Orhan Karsak, H. G. & Maner, A. F. (2023). The effect of the Montessori method integrated with collaborative learning on early mathematical reasoning skills. *International Journal of Contemporary Educational Research, 10*(4), 917-929. https://10.52380/ijcer.2023.10.4.505

International Journal of Contemporary Educational Research
Volume 10, Number 4, December 2023, 917-929 ISSN: 2148-3868

The Effect of the Montessori Method Integrated with Collaborative Learning on Early Mathematical Reasoning Skills*

Kardelen Ön Hallumoğlu[1†], H. Gülhan Orhan Karsak[2], Ayşe Fulya Maner[3]
[1] Ministry of National Education
[2] Kırklareli University
[3] Kırklareli University

Abstract

The purpose of the study was to explore the effect of the Montessori Method integrated with cooperative learning on mathematical reasoning skills in the preschool period. In this study, an experimental design with a pretest-posttest control group was used. The study group included a total of 30 children, 15 of whom were in the experimental group and 15 in the control group. The study was conducted with mathematics teaching supported by the Montessori Method integrated with cooperative learning activities in the experimental group and mathematics teaching supported by the Turkish Ministry of National Education (MoNE) Preschool Curriculum (2013) in the control group. The "Evaluation Instrument for the Early Mathematical Reasoning Skills" was used as the data collection tool, and the data were analyzed with the Mann-Whitney U Test in line with the gender and reasoning variables. When the performances of the experimental group students who were taught mathematics supported by the Montessori Method integrated with cooperative learning and the control group students who were taught mathematics supported by the Turkish MoNE Preschool Curriculum (2013) were compared, a significant difference in favor of the experimental group was determined. However, no significant difference was determined in experimental and control group students' reasoning skills according to gender. By integrating the Montessori Method with different methods, materials, and techniques, its effects on developmental areas can be investigated.

Keywords: preschool education, reasoning, mathematics, Montessori method, collaborative learning

Introduction

In the literature, there are various studies conducted in order to reveal the individual changes and developments that Montessori Method applications provide for children (Cossentino, 2006; Duckworth, 2006; Deluca & Hughes, 2014; Macià-Gual & Domingo-Peñafiel, 2021). However, there are also criticisms of the method in the literature, arguing that structured materials and the cerated environment lead children to intense individual thinking and restrict social communication and cooperation (Kilpatrick, 1914; DeVries & Goncu, 1987; Rathunde & Csikszentmihalyi, 2005; Beatty, 2011; Kayılı & Arı, 2016). The criticisms stated that social development is as important as individual development in preschool children and drew attention to the fact that it is very important to support adaptation and group cooperation. In line with these views, it would not be wrong to say that children's communication with their peers in the learning process is of great importance for the effectiveness of learning. Active communication with their peers in the learning process can also support the development of children's mathematical thinking skills, such as reasoning and problem solving. The frequent use of the cooperative learning method in the process of attainment of mathematical skills in the literature supports these ideas (Leikin & Zaslavsky, 1997; Lavasani & Khandan, 2011; Siew, Chin & Sombuling, 2017; Rambe, Syahputra, & Elvis, 2020).
The relevant literature argues that different methods and techniques used to support the acquisition of mathematical thinking and reasoning skills in the preschool period play an effective role in the learning process of the children. It can be stated that examining the different methods and techniques used in preschool education

* This study is a part of the master's thesis prepared by the first author under the supervision of the second and third authors.
† Corresponding Author: *Kardelen Ön Hallumoğlu, onkardelen@gmail.com*

and integrating and reflecting their effective aspects into the teaching process will also appeal to the individual differences of children. Studies have revealed the positive effects of implementing robotics applications (Elkin, Sullivan & Bers, 2014), STEM activities (Çakır & Altun Yalçın, 2022), music activities (Rajan, 2017; Dansereau & Wyman, 2020), and movement activities (Laure & Habe, 2023) with the Montessori Method. However, Montessori Method applications integrated with cooperative learning were not found in the literature. In this context, it is predicted that the study will bring a new perspective to the literature, and this aspect reveals the importance of the study. It can be foreseeable that the use of collaborative learning activities with intense group communication in addition to the Montessori Method's mathematical materials and individual tasks as an answer to the criticisms directed at the Montessori Method about intensive individual tasks limiting social interaction will be effective on the related skills. In line with this prediction, the purpose of this study was to examine the effects of the Montessori Method integrated with cooperative learning on preschool children's attainment of mathematical reasoning skills. Within the scope of this study, the problem statement was determined as 'Does the Montessori Method integrated with cooperative learning have an effect on early mathematical reasoning skills?' The determined problem statement was tested within the scope of the hypotheses and sub-dimensions presented below:

- The performance of the mathematical reasoning skills of preschool children who were taught with the Montessori Method integrated with cooperative learning is higher than that of the children who were taught with the MoNE (2013) Preschool Curriculum.
- Mathematical reasoning skills performance of preschool children who were taught with the Montessori Method integrated with cooperative learning shows a significant difference according to gender.
- Mathematical reasoning skills and performance of preschool children who were taught with the MoNE (2013) Preschool Curriculum shows a significant difference according to gender.

Mathematical Reasoning Skills in the Preschool Period

There are many studies revealing that preschool education aims to support children in all developmental areas, adapts to their developmental characteristics and individual differences, and helps them discover their existing potentials (Dearing, McCartney, & Taylor, 2009; Burchinal, Vandergrift, Pianta, & Mashburn, 2010; Gomes & Pereira, 2014; Manigo & Alison, 2017). Since 80% of human development occurs in this period, this period has a very important role in human life (Duffy, 1998). Children who receive preschool education continuously improve themselves in areas such as cognitive, social-emotional, psychomotor, and language development (Reynolds, 2004). Qualified and adequate educational support will be beneficial in raising children with high cognitive levels in the preschool period, especially when cognitive development is quite rapid (Whitebread & Coltman, 2015).

The most important task in the cognitive development of children is physical awareness, in line with coordinated studies (Lillard, 1996). In the preschool period, children focus directly on what they see, and this helps them gain physical knowledge. As children gain physical awareness, they are highly motivated and go into the effort of exploration. The physical knowledge they gain forms the basis for logical reasoning (Ayvacı, 2010). This whole process is a sign that children are getting ready for the acquisition of mathematical thinking skills. The mathematical reasoning process begins in early childhood with an awareness of quantity and size. This is followed by the skills of counting in sequence, understanding the connection between numbers and the amount they represent, comprehending the last digit indicating the number of objects in a row, producing solutions to simple arithmetic problems, and trying different estimation strategies using effective techniques (Sarnecka & Gelman, 2004; Geary, 2006).

The mathematical experiences children gain enable them to understand their own world, and in line with these experiences, children lay the mathematical foundations necessary for their success in their educational lives (Charlesworth & Lind, 2010). In the literature, there are many different studies investigating the effects of learning methods and techniques on mathematical thinking skills used in the education process (Rauscher et al., 1997; Clements & Sarama, 2008; Sumpter & Hedefalk, 2015; Ahmed, Mengistie, & Wondimu, 2020; Murtazaevich, 2020). The Montessori Method, which gives importance to the training of the senses based on physical learning, is among these methods.

Montessori Method and Mathematics Materials

Maria Montessori focused on the education of the senses and accordingly developed sensory materials that create an environment for children to learn through exploration (Lillard, 2007). The relevant materials used as a learning method in the Montessori Method aim to facilitate children's learning by concretizing mathematical concepts. Montessori creates an exploration area for children with the materials she uses in the method she developed and observes them in their own exploration area. Children experience their own experiences with the help of sensory materials in the exploration environment offered to them, and the foundations of logical thinking begin to be laid during this period. (Lillard, 2013). In addition, the individual use of materials encourages

children to stay connected to their own learning speed and control their mistakes, encouraging them to work independently without a need for others (Denervaud, Knebel, Immordino-Yang, & Hagmann, 2020).
Muchyidin and Priatna (2022) found that students who used Montessori mathematics materials were able to convey their mathematical ideas orally or in writing and use mathematical concepts more qualitatively. According to the results of Faryadi’s (2017) study, Montessori mathematics materials increased children's learning success by improving their problem-solving skills and positive classroom behaviors. However, some research (Basargekar & Lillard, 2021; Brown & Lewis, 2017; Mallett & Schroeder, 2015) investigating the math achievement and learning of Montessori students and alumni has not consistently found the instruction that is based on Montessori to be more effective than other instructional approaches. The results of research in the literature regarding whether Montessori materials and teaching have effects on mathematics are inconsistent. This situation requires further study on the subject.

Method

Study Design

Since the effect of the Montessori Method integrated with cooperative learning on early mathematical reasoning skills was explored in the study, an experimental design with a pretest-posttest control group was employed. Experimental design is a research design that aims to determine cause-and-effect relationships between variables by examining any situation and comparing the results (Hinkelmann & Kempthorne, 2005).

Study Group

The experimental group, who were taught with the Montessori Method integrated with cooperative learning, included eight girls and seven boys (n=15), and the control group, who were taught with the MoNE Preschool Curriculum (2013), included seven girls and eight boys (n=15). While forming the study group, a classroom from the Y preschool, which had Montessori mathematics materials required by the study and used the Montessori Method, and a classroom from the X preschool, which was in a close neighborhood to the Y preschool in the same district and used only the MoNE Preschool Curriculum (2013) and was closest to the experimental group in terms of age, were selected as the experimental group and the control group, respectively, using the purposive sampling method. The purposeful association of systematic and randomly selected case samples for the study purpose is defined as purposive sampling (Marshall & Rossman, 2014). The study group was formed by simple random sampling from the classrooms, determined by purposive sampling. Simple random sampling refers to each member of a group having the same chance of being included in the sample (West, 2016). Information on the selected study group is presented in Table 1.

Table 1. Study Group

School/Center	Classroom	Number of Children
Y Preschool	Morning Group	15
X Preschool	Morning Group	15
Total		30

As seen in Table 1, in this study, 15 subjects for the experimental group and 15 subjects for the control group were selected impartially. The gender distribution of the subjects participating in the study is presented in Table 2.

Table 2. Gender Distribution

Gender	Experimental Group	Control Group	Total
Girl	8	7	15
Boy	7	8	15
Total	15	15	30

As seen in Table 2, the experimental group of the present study consisted of eight girls and seven boys, and the control group consisted of seven girls and eight boys. There were 15 children in both groups, and the study group consisted of a total of 30 children.

Equivalency Process

In order to examine the equivalence between the experimental and control groups, the mathematical reasoning skills pretest scores of the experimental and control groups were compared. The results obtained are presented in Table 3.
Table 3. Mann-Whitney U Test Results Regarding Pretest Scores of the Experimental and Control Groups

	Groups	N	Mean Rank	Sum of Ranks	U	p
Mathematical Reasoning	Experimental	15	18,47	277,00	68,0	0,067
	Control	15	12,53	188,00		

According to Table 3, when Mann-Whitney U Test values comparing the pre-test scores of preschool children who will be applied collaborative mathematics activities supported by Montessori materials and preschool children who will be applied mathematics activities supported by MoNE (2013) Preschool Curriculum are examined, there is no statistically significant difference (U= 68,0, p>.05) between the groups. In this case, the experimental and control groups were considered equal for their mathematical reasoning skills.

In order to examine the equivalence of the mathematical reasoning skills of the experimental group according to gender, the pretest scores of the boys and girls were compared. The results obtained are presented in Table 4.

Table 4. Mann-Whitney U Test Results Regarding Pretest Scores of the Experimental Group According to Gender

	Groups	N	Mean Rank	Sum of Ranks	U	p
Mathematical Reasoning	Girl	8	1,11	7,75	26,0	0,82
	Boy	7	1,24	8,29		

According to Table 4, when the pre-test scores of preschool girls and boys who participated in collaborative mathematics activities supported by Montessori materials in the experimental group are compared, there is no statistically significant difference (U=26.0, p>.05) according to gender. In this case, the experimental group was considered equal in terms of the mathematical reasoning skills of the boys and girls.

In order to examine the equivalence of mathematical reasoning skills in the control group according to gender, the pretest scores of the boys and girls were compared. The results obtained are presented in Table 5.

Table 5. Mann-Whitney U Test Results Regarding Pretest Scores of the Control Group According to Gender

	Groups	N	Mean Rank	Sum of Ranks	U	p
Mathematical Reasoning	Girl	7	1,13	7,79	26,5	0,86
	Boy	8	1,10	8,19		

According to Table 5, when the pre-test scores of preschool girls and boys who participated in the activities of MoNE (2013) Preschool Curriculum in the control group are compared, there is no statistically significant difference (U=26.5, p>.05) according to gender. In this case, the control group was considered equal in terms of the mathematical reasoning skills of the boys and girls.

Data Collection Tools

The study data were collected using the "Evaluation Instrument for the Early Mathematical Reasoning Skills" developed by Ergül (2014). Of the 40 questions in the measurement tool, 21 are about measurement, and 19 are about data analysis and probability. There are 21 questions on inductive reasoning and 19 questions on deductive reasoning. The general skills in the questions about measurement include comparing objects and events, measuring non-standard units, comparing measurement results, sequencing time, estimating, and examining the situation in which the result is given. The general skills in the questions about data analysis and probability include sorting and classifying objects, making graphics using real materials, making graphics using the pictures of objects, making graphics using symbols, reading one-dimensional graphics, reading two-dimensional graphics, assessing a situation or data in an event, questioning the probability status according to the data obtained because of the assessment, and making situational or numerical estimations. Twenty-eight of the questions in the scale are communicated to the children verbally through the prepared pictures, nine of them using various materials, and the remaining three questions are communicated to the children verbally without using any material. In the study, a rubric was preferred for reasons such as the importance of the process in mathematical reasoning studies and the small age group. A rubric was created for the assessment tool, and each question was scored on a scale of 0-5 according to the children's answers. For the reliability studies of the assessment tool, a test-retest application was conducted with 40 children. The test-retest reliability for all domains in the assessment tool was found to be above .98.

Implementation Process

Before proceeding to the implementation process related to the study, a general meeting was held with the teachers of the classes constituting the experimental and control groups regarding the purpose and subject of the study and the data collection tools to be used in it. In the first stage of the process, the "Evaluation Instrument for the Early Mathematical Reasoning Skills" was administered to all groups simultaneously by the classroom teachers in order to determine the mathematical reasoning skills of the children in the experimental and control groups before they started their preschool education.

In the second stage of the process, the children in the experimental group were taught mathematics using the Montessori method. In the experimental group, mathematics activities planned with the Think Pair Share technique based on cooperative learning were carried out. On the other hand, the control group was only taught mathematics with the MoNE (Ministry of National Education) (2013) Preschool Curriculum by the classroom teacher.

When the process was completed, the "Evaluation Instrument for the Early Mathematical Reasoning Skills" was administered to the children in the experimental and control groups as a posttest by the groups' classroom teachers.

Data Analysis

Since the number of participants in the groups was below 30, a non-parametric test was preferred (Çokluk, Şekercioğlu & Büyüköztürk, 2021). Therefore, since the number of participants in each group is 15, the data were analyzed with the Mann-Whitney U test in line with the hypotheses. Mann-Whitney U tests are used to compare two independent groups and test whether the findings differ significantly from each other (Nachar, 2008).

Results and Discussion

The first hypothesis of the study was that "the performance of the mathematical reasoning skills of preschool children who were taught with the Montessori Method integrated with cooperative learning is higher than the children who were taught with the MoNE Preschool Curriculum (2013)." The data from the Mann-Whitney U test performed for the related hypothesis are presented in Table 6.

Table 6. Mann-Whitney U Test Results Regarding Posttest Scores of Experimental and Control Group Children

		Groups	N	Mean Rank	Sum of Ranks	U	p
MESUREMENT		Experimental	15	3,58	23,0	9,2	0,00*
		Control	15	2,35	8,0		
Induction		Experimental	15	3,77	22,40	9,0	0,00*
		Control	15	2,47	8,60		
	Length and Weight	Experimental	15	4,37	21,53	22,0	0,00*
		Control	15	3,19	9,47		
	Area and Volume	Experimental	15	3,63	23,0	23,7	0,00*
		Control	15	2,13	8,0		
	Sequencing Time	Experimental	15	3,10	21,07	29,0	0,00*
		Control	15	2,09	9,93		
Deduction		Experimental	15	3,39	21,97	15,5	0,00*
		Control	15	2,23	9,03		
	Testing	Experimental	15	3,84	21,37	24,5	0,00*
		Control	15	2,51	9,63		
	Comparing Word Problems	Experimental	15	2,93	21,03	29,5	0,00*
		Control	15	1,96	9,97		
DATA ANALYSIS	and PROBABILITY	Experimental	15	3,38	22,93	1,0	0,00*
		Control	15	2,18	8,07		
Induction		Experimental	15	3,78	22,33	10,0	0,00*
		Control	15	2,89	8,67		
	Knowing the Properties of Shapes	Experimental	15	4,51	21,30	25,5	0,00*
		Control	15	3,40	9,70		
	Making Graphs	Experimental	15	3,04	19,53	52,0	0,01*
		Control	15	2,38	11,47		
Deduction		Experimental	15	2,99	22,87	2,0	0,00*
		Control	15	1,47	8,13		

	Examining the Picture and Guessing the Situation in the Picture	Experimental	15	3,23	20,57	36,5	0,00*
		Control	15	2,12	10,43		
	Reading Graphs and Telling the Results	Experimental	15	3,20	21,67	20,0	0,00*
		Control	15	1,76	9,33		
	Specifying Probability	Experimental	15	2,53	22,80	3,0	0,00*
		Control	15	0,54	8,20		
Mathematical Reasoning		Experimental	15	3,48	23,0	2,4	0,00*
		Control	15	2,27	8,0		

As seen in Table 6, the values (U=2,4 p<.05) of the Mann-Whitney U test comparing the mathematical reasoning skill performances of preschool children who were taught with the Montessori Method integrated with cooperative learning and preschool children who were taught with the MoNE Preschool Curriculum (2013) showed that there was a significant difference in favor of the experimental group.

There was a significant difference in the posttest scores in the measurement (U=9,2, p<.05) and data analysis-probability (U=1,0, p<.05) list and in the posttest scores of induction (U=9,0, p<.05) and deduction (U=15,5, p<.05) dimensions in the measurement list in favor of the experimental group. A significant difference was also found in favor of the experimental group in the posttest scores of the deduction dimension's length and weight (U=22,0, p<.05), area and volume (U=23,7, p<.05), sequencing time (U=29,0, p<.05) and induction dimension's testing (U=24,5, p<.05) and comparing word problems (U=29,5, p<.05) skills.

In addition, there was a significant difference in the posttest scores of the induction (U=10,0, p<.05) and deduction (U=2,0, p<.05) dimensions in the data analysis-probability list in favor of the experimental group. A significant difference was also found in favor of the experimental group in the posttest scores of the induction dimension's knowing the properties of shapes (U=25,5, p<.05), and making graphs (U=52,0, p<.05) skills and posttest scores of the induction dimension's examining pictures and guessing the situation in the picture (U=36,5, p<.05), reading graphs and telling the results (U=20,0, p<.05) and specifying probability (U=3,0 p<.05) skills.

The second hypothesis of the study was that "the mathematical reasoning skills performance of preschool children who were taught with the Montessori Method integrated with cooperative learning shows a significant difference according to gender." The data from the Mann-Whitney U test performed for the related hypothesis are presented in Table 7.

Table 7. Mann-Whitney U Test Results Regarding the Posttest Scores of the Experimental Group Children According to Gender

			Groups	N	Mean Rank	Sum of Ranks	U	P
MEASUREMENT			Female	8	3,50	7,06	20,5	0,38
			Male	7	3,67	9,07		
	Induction		Female	8	3,74	7,19	21,5	0,45
			Male	7	3,81	8,93		
		Length and Weight	Female	8	4,40	8,13	27,0	0,91
			Male	7	4,33	7,86		
		Area and Volume	Female	8	3,65	8,19	26,5	0,86
			Male	7	3,62	7,79		
		Sequencing Time	Female	8	3,17	7,31	22,5	0,52
			Male	7	3,47	8,79		
	Deduction		Female	8	3,27	7,31	22,5	0,52
			Male	7	3,52	8,79		
		Testing	Female	8	3,63	6,75	18,0	0,24
			Male	7	4,10	9,43		
		Comparing Word Problems	Female	8	2,92	8,06	27,5	0,95
			Male	7	2,95	7,93		
DATA ANALYSIS and PROBABILITY			Female	8	3,29	6,69	17,5	0,22
			Male	7	3,49	9,50		

Induction		Female	8	3,75	7,63	25,0	0,72
		Male	7	3,81	8,43		
	Knowing the Properties of Shapes	Female	8	4,58	8,75	22,0	0,46
		Male	7	4,43	7,14		
	Making Graphs	Female	8	2,92	7,69	25,5	0,77
		Male	7	3,19	8,36		
Deduction		Female	8	2,84	6,81	18,5	0,27
		Male	7	3,16	9,36		
	Examining the Picture and Guessing the Situation in the Picture	Female	8	3,03	7,06	20,5	0,37
		Male	7	3,46	9,07		
	Reading Graphs and Telling the Results	Female	8	3,08	7,25	22,0	0,48
		Male	7	3,33	8,86		
	Specifying Probability	Female	8	2,40	6,50	16,0	0,16
		Male	7	2,69	9,71		
Mathematical Reasoning		Female	8	3,40	6,75	18,0	0,25
		Male	7	3,58	9,43		

As seen in Table 7, the values (U=18,0, p<.05) of the Mann-Whitney U test comparing the mathematical reasoning skill performances of preschool children who were taught with the Montessori Method integrated with cooperative learning showed that there was no significant difference according to gender. No significant difference was found in the posttest scores in the measurement (U=20,5, p<.05) and data analysis-probability (U=17,5, p<.05) list and in the posttest scores of induction (U=21,5, p<.05) and deduction (U=22,5, p<.05) dimensions in the measurement list according to gender. A significant difference was also not found in the posttest scores of the deduction dimension's length and weight (U=27,0, p<.05), area and volume (U=26,5, p<.05), sequencing time (U=22,5, p<.05), and induction dimension's testing (U=18,0, p<.05) and comparing word problems (U=27,5, p<.05) skills according to gender.

Furthermore, there was no significant difference in the posttest scores of induction (U=25,0, p<.05) and deduction (U=18,5, p<.05) dimensions in the data analysis-probability list, the posttest scores of induction dimension's knowing the properties of shapes (U=22,0, p<.05), and making graph (U=25,5, p<.05) skills, and posttest scores of induction dimension's examining pictures and guessing the situation in the picture (U=20,5, p<.05), reading graphs and telling the results (U=22,0, p<.05) and specifying probability (U=16,0, p<.05) skills according to gender.

The third hypothesis of the study was that "the mathematical reasoning skills performance of preschool children who were taught with the MoNE Preschool Curriculum (2013) shows a significant difference according to gender." The data from the Mann-Whitney U test performed for the related hypothesis are presented in Table 8.

Table 8. Mann-Whitney U Test Results Regarding the Posttest Scores of the Control Group Children According to Gender

			Groups	N	Mean Rank	Sum of Ranks	U	p
MEASUREMENT			Female	7	2,32	7,57	25,0	0,73
			Male	8	2,38	8,38		
	Induction		Female	7	2,49	8,36	25,5	0,77
			Male	8	2,45	7,69		
		Length and Weight	Female	7	3,26	8,21	26,5	0,86
			Male	8	3,13	7,81		
		Area and Volume	Female	7	2,21	9,00	21,0	0,41
			Male	8	2,06	7,13		
		Sequencing Time	Female	7	2,00	7,21	22,5	0,52
			Male	8	2,17	8,69		
	Deduction		Female	7	2,14	7,07	21,5	0,45
			Male	8	2,31	8,81		
		Testing	Female	7	2,38	7,00	21,0	0,41
			Male	8	2,62	8,88		

		Comparing Word Problems	Female	7	1,90	7,36	23,5	0,59
			Male	8	2,00	8,56		
DATA ANALYSIS and PROBABILITY			Female	7	2,33	10,00	14,0	0,11
			Male	8	2,05	6,25		
	Induction		Female	7	3,07	10,07	13,5	0,08
			Male	8	2,73	6,19		
		Knowing the Properties of Shapes	Female	7	3,48	8,36	25,5	0,77
			Male	8	3,33	7,69		
		Making Graphs	Female	7	2,67	9,86	15,0	0,13
			Male	8	2,13	6,38		
	Deduction		Female	7	1,59	9,00	21,0	0,42
			Male	8	1,37	7,13		
		Examining the Picture and Guessing the Situation in the Picture	Female	7	2,18	8,21	26,5	0,86
			Male	8	2,06	7,81		
		Reading Graphs and Telling the Results	Female	7	1,95	9,07	20,5	0,38
			Male	8	1,58	7,06		
		Specifying Probability	Female	7	0,64	9,57	17,0	0,19
			Male	8	0,46	6,63		
Mathematical Reasoning			Female	7	2,32	9,00	21,0	0,42
			Male	8	2,22	7,13		

As seen in Table 8, the values (U=18,0, p<.05) of the Mann-Whitney U test comparing the mathematical reasoning skill performances of preschool children who were taught with the MoNE Preschool Curriculum (2013) showed that there was no significant difference according to gender.

No significant difference was found in the posttest scores in the measurement (U=25,0, p<.05) and data analysis-probability (U=14,0, p<.05) list and in the posttest scores of induction (U=25,5, p<.05) and deduction (U=21,5, p<.05) dimensions in the measurement list according to gender. A significant difference was also not found in the posttest scores of deduction dimension's length and weight (U=2635, p<.05), area and volume (U=21,0, p<.05), sequencing time (U=22,5, p<.05), and induction dimension's testing (U=21,0, p<.05) and comparing word problems (U=23,5, p<.05) skills according to gender.

In addition, there was no significant difference in the posttest scores of induction (U=13,5, p<.05) and deduction (U=21,0, p<.05) dimensions in the data analysis-probability list, the posttest scores of induction dimension's knowing the properties of shapes (U=25,5, p<.05), and making graph (U=15,0, p<.05) skills, and posttest scores of induction dimension's examining pictures and guessing the situation in the picture (U=26,5, p<.05), reading graphs and telling the results (U=20,5, p<.05) and specifying probability (U=17,0, p<.05) skills according to gender.

Conclusion

The study findings supported the first hypothesis, "The performance of the mathematical reasoning skills of preschool children who were taught with the Montessori Method integrated with cooperative learning is higher than the children who were taught with the MoNE Preschool Curriculum (2013)."

The main reason behind the significant improvement in the length-weight and area-volume measurement skills in the measurement list in the posttest data can be considered as the lesson plans developed with the Montessori Method integrated with cooperative learning strengthened the interaction in children and encouraged them to learn effectively. In a similar study, Nisa, Ariyanto, and Asyhar (2019) examined the effect of Montessori education on the mathematical thinking skills of children in early childhood. The aforementioned study, which included skills such as measuring the length and weight of an object and understanding mathematical concepts, revealed the effect of Montessori education and supports the findings of the present study. By working in cooperation, the lesson plans developed additionally, and cooperative learning supported children to reinforce these concepts, which they concretized in their minds with the help of the Montessori materials. The fact that Clements (2019) stated that cooperative learning is effective in the development of basic mathematical skills in his study, in which he examined the acquisition of these skills in preschool children, supports the present study's findings.

The reason for the significant difference in the time sequencing skill in the measurement list can be explained by the integrated application addressing children's individual differences. Charlesworth (2011) argued that the concept of time as a measurement concept is difficult for children to acquire. Skills such as classification, sequencing, and establishing a part-whole relationship are prerequisites for acquiring the concept of time in the preschool period. In this respect, it can be stated that Montessori materials visually concretize difficult-to learn abstract concepts such as time, and cooperative activities enable children to establish cause-and-effect relationships between events more easily and facilitate the understanding of concepts such as 'today', 'tomorrow', and 'yesterday'. According to Lyons (2022), in so many ways, cooperative games align with Montessori's insightful views on education. Also, Clements (2022) concluded that preschool children exhibited all peer cooperation behaviors, there was preliminary evidence of supportive behavior in pairs, and children's counting scores increased. Brožová (2022) states that Montessori activities used in mathematics education are suitable for personalization, responsibility, and flexibility. The results of many different studies (Siljehag & Allodi, 2023; Hanish et al., 2023; Jin & Moran, 2023) show that collaborative studies used in preschool education increase interaction between children, support positive peer relationships, and provide a frequency of coordinated behaviors. The mentioned studies show that collaborative activities integrated with Montessori education improve mathematical reasoning skills by contributing to both individual and social development, similar to the result of this study.

The reason for the significant difference in testing and comparing word problem skills in the measurement list can be interpreted as the children using Montessori materials testing their mistakes without the need for any other external control and producing alternative solutions to problems by improving their self-expression skills with the help of cooperative activities. In his study examining the mathematical skills of preschool children, Faryadi (2017) revealed that the group who were taught the Montessori Method had more advanced problem-solving skills than the group who were taught the traditional curriculum. Bahatheg (2010) examined the effect of the Montessori Method on creative problem-solving skills in a study conducted in a preschool with 24 students and put forth that there were significant differences between groups in terms of problem-solving capacities. Also, Gentaz and Richard (2022) concluded that the problem-solving skills of children who were educated with the Montessori approach were higher than those who received traditional education. Lyman and Foyle (1988) explained the importance of using the cooperative learning method in preschools and the first years of elementary school. The study concluded that the use of this method over a long period of time is meaningful in the development of communication, active role-playing, problem-solving, and probability thinking skills in children. Jin and Moran (2021) examined teachers' views on preschool children's problem-solving skills based on cooperation in their study. The participating teachers stated that cooperative learning is effective in developing problem-solving skills. This is in line with the results of the present study.

The reason behind the significant difference in the knowing the properties of shapes skill in the data analysis and probability list can be interpreted as the children's learning basic mathematical concepts with the support of materials that develop their senses, and then working in cooperation with their friends and making the learning permanent. In their study examining Montessori materials, Shatri, Bajraj, Berisha, and Kendusi (2021) stated that children are more interested in concrete things than abstract things and that the use of these didactic materials, which have many different forms such as shape, size, and weight, by educators would be beneficial in facilitating the learning process. Lillard and Else-Quest (2006) also revealed that mathematical thinking skills are more advanced in children who use Montessori materials. Zippert et al. (2019) determined that children who are more interested in cooperative play in early childhood explore more advanced mathematical concepts and engage in verbal mathematics works, as well as basic skills such as shape, spatial, and pattern. Also, Goss (2022) stated that children have ample opportunities to engage with challenging math problems, and challenging problems require spatial reasoning. Engaging activities enable children to reason mathematically in a broad range of ways and develop a range of spatial skills. In this direction, the findings of the aforementioned studies are in parallel with the results of the present study.

The reason for the significant difference in making graphs, reading graphs and telling the results, guessing the situation in the picture, and specifying probability in the data analysis and probability list can be interpreted as the children who learned basic mathematical concepts with the Montessori Method applications integrated with cooperative learning improving their skills like estimation, reasoning, logical probability, and evaluation of results. Aktaş Arnas (2012) listed the mathematical skills acquired in preschool education as classification, one-to-one matching, comparison, ranking, number concept, operation concept, geometry and spatial thinking, measurement, and graphs. As can be seen in this direction, the skills of making graphs, reading graphs, and telling the results in children are acquired after basic mathematical skills. Children learn all these skills as a prerequisite when making graphs. In his study, Charlesworth (2005) expressed that children's data collection and interpretation skills develop by collecting data throughout their lives and showing the results with a simple graph. In addition, the 2000 publication by the National Council of Teachers of Mathematics (NCTM) describing the mathematical skills and processes acquired in schools includes data analysis and probability as the final stage in the content standards. Data analysis and probability skills, which are acquired after number and operation, algebra, geometry, and measurement skills, include statistical reasoning, analyzing data, and making inferences and predictions based on it. In this direction, it can be stated that this skill is acquired at the end of a very comprehensive process for children in the preschool period, and thus observing and integrating the effective aspects of different methods and techniques and using them in the education process will meet children's different interests and demands and will support their individual learning speeds from different aspects. Tan, Harji, and Lau (2011) supported this research's results with their idea that an interactive, collaborative, and supportive learning environment, such as structuring with peers and adults, helps to overcome learning barriers as well as anxieties and elevates learners to a higher level of development as they gain conceptual and procedural knowledge.

The scores of the posttest used in the present study did not support the second hypothesis, "Mathematical reasoning skills performance of preschool children who were taught with the Montessori Method integrated with cooperative learning shows a significant difference according to gender," and the third hypothesis, "Mathematical reasoning skills performance of preschool children who were taught with the MoNE Preschool Curriculum (2013) shows a significant difference according to gender."

There are many studies in the literature examining mathematical skills according to gender (Beller & Gafni, 1996; Bierman, Torres, Domitrovich, Welsh, & Gest, 2009; Slot, Bleses, & Jensen, 2020). Mathematical anxiety not being at a high level for both genders, and the teachers of both groups not having a prejudice against any of the genders about their acquisition of mathematical skills, may be the reason why no significant difference was observed in the acquisition of mathematical skills in the present study. In their study, Tovazzi and Caprara (2019) examined the Montessori Method, mathematics education, and gender differences. They stated that teachers' prejudices are effective in influencing the interests and attitudes of male and female students towards mathematics. In this respect, they argued that the potential results on mathematical concepts in schools where the Montessori Method is used may be equal for both genders. They explained this by stating that the Montessori teacher's role is to be an observer in the education process and that his or her personal characteristics do not affect children. The results of the aforementioned study support the findings of the present study.

The present study's finding that the mathematical reasoning skills of children did not differ according to gender was also supported by the study conducted by Klein, Adi-Japha, and Hakak-Benizri (2010). In their study, they examined the effect of gender differences on verbal, spatial, and mathematical interaction variables. According to the results of this study, which was conducted with 80 children aged 5-6 years attending preschool education institutions, no significant difference was found between girls and boys in terms of their mathematical, verbal, and spatial skills. Harris (2005) made a similar study by integrating Montessori education with music and examining the effect of this education on mathematics achievement in terms of gender. The fact that Montessori education enriched with music did not show a significant difference according to the gender variable supports the findings of the present study. However, in his study, in which he used tests based on mathematical reasoning at national standards, Becker (1990) stated that there was a significant gender difference in contrast to the studies conducted in preschools. When students' gender differences in the subject area and item type are examined, girls had more difficulty in the field of algebra and boys in the section with mixed questions. Thus, this finding does not support the findings of the present study.

Limitations and Recommendations

During the implementation phase of the study, one child from the experimental and control groups was excluded from the study at the request of their parents. In addition, more children can be studied to increase the generalizability of the study.

The Montessori Method, which is applied in early childhood, can be integrated with different education and training techniques. By using teaching techniques integrated with relevant materials, the effects of the child on other developmental areas can be investigated.

Author (s) Contribution Rate

Researching the idea and the method that will lead to the results second author at the stage of designing and supervising; third author at the stage of following the progress and organizing the execution of the study; the necessary place to study; resources; provision of tools; and evaluation of findings during the finalization phase. The first author contributed to the study.

Conflicts of Interest

The authors declare that they have no conflict of interest.

Ethical Approval (only for necessary papers)

This study was approved by the Kırklareli University Institute of Health Sciences Ethics Committee on August 6, 2018 (Decision No. 09).

References

Ahmed, A.M., Mengistie, S.M, & Wondimu, T.E. (2020). Comparison of cooperative problem-solving of mathematics teaching method with traditional (lecture) method: Thecase of Awi-zone, Ethiopia. International Journal of Education & Management. 10 (1), 71-74.

Aktaş Arnas, Y. (2012). Okul öncesi dönemde matematik eğitimi. Ankara: Vize Yayıncılık.

Ayvacı, H. Ş. (2010). Okul öncesi dönem çocuklarının bilimsel süreç becerilerini kullanma yeterliliklerini geliştirmeye yönelik pilot bir çalışma. NEF-EFMED, 4 (7), 1-24.

Bahatheg, R. O. (2010). How the use of Montessori sensorial material supports children's creative problem solving in the pre-school classroom. (Unpublished doctoral dissertation). University of Southampton.

Basargekar, A. & Lillard, A. S. (2021). Math achievement outcomes associated with Montessori education". Early Child Development and Care, 191(7-8), 1207-1218, DOI: 10.1080/03004430.2020.1860955

Beatty, B. (2011). The dilemma of scripted instruction: comparing teacher autonomy, fidelity, and resistanc e in the Froebelian Kindergarten, Montessori, direct instruction, and success for all. Teachers College Record. 113 (3), 395-430.

Becker, B. J. (1990). Item characteristics and gender differences on the SAT-M for mathematically able youths. American Educational Research Journal, 27 (1), 65-87.

Beller, M. & Gafni, N. (1996). The 1991 İnternational assessment of educational progress in mathematics and sciences: The gender differences perspective. Journal of Educational Psychology, 88 (2), 365-377.

Bierman, K. L., Torres, M.M., Domitrovich, C. E., Welsh, J.A. & Gest, S. D. (2009). Behavioral and cognitive readiness for school: Cross-domain associations for children attending Head Start. Social Development, 18 (2), 305–323. DOI: 10.1111/j.1467-9507.2009.00490.x

Burchinal, M., Vandergrift, N. Pianta, R. & Mashburn, A. (2010). Threshold analysis of the association between child care quality and child outcomes for low-income children in pre-kindergarten programs. Early Childhood Research Quarterly, 25 (2), 166-176. DOI: 10.1016/j.ecresq.2009.10.0004

Brožová, M. (2022). Personalisation in Montessori environments during mathematics lessons. Annales Universitatis Paedagogicae Cracoviensis, Studia Ad Didacticam Mathematicae Pertinentia, 14, 139–157. https://doi.org/10.24917/20809751.14.8

Brown, K. & Lewis, C. W. (2017). A comparison of reading and math achievement for African American third grade students in Montessori and other magnet schools. The Journal of Negro Education, 86(4), 439-448.

Charlesworth, R. (2011). Experiences in math for young children". Cengage Learning.

Charlesworth, R. (2005). Prekindergarten mathematics: connecting with national standards. Early Childhood Education Journal. 32(4), 229-236.

Charlesworth, R. & Lind. K.K. (2010). Math and science for young children. Belmont: Cengage Learning.

Clements, D. H. & Sarama, J. (2008). Young children and technology: What does the research say?. Young Children, 58 (6), 34-40.

Clements, L.J. (2019). Cooperation between preschool peers in relation to their math learning during dyadic activities. (Unpublished doctoral dissertation). Boston College University.

Clements, L.J. (2022). Cooperation between preschool peers in relation to their math learning. The Journal of Educational Research, 115(3), 199-208.

Cossentino, J M. (2006). Big work: Goodness, vocation, and engagement in the Montessori Method. Curriculum Inquiry, 36(1), 63-92.

Çakır, Z. & Altun Yalçın, S. (2022). The Effect of Montessori Approach-based STEM Education on Pre-service Pre-school Teachers' Self-directed Learning. e-Uluslararası Eğitim Araştırmaları Dergisi, 13 (2), 142-162. DOI: 10.19160/e-ijer.1038793

Çokluk, Ö., Şekercioğlu, G. & Büyüköztürk, Ş. (2021). Sosyal bilimler için çok değişkenli istatistik: SPSS ve LISREL uygulamaları. Ankara: Pegem Akademi.

Dansereau, D. R., & Wyman, B. M. (2020). A Child-Directed Music Curriculum in the Montessori Classroom: Results of a Critical Participatory Action Research Study. Journal of Montessori Research, 6(1), 19–31. https://doi.org/10.17161/jomr.v6i1.10631

Dearing, E., McCartney, K. & and Taylor, B.A. (2009). Does higher quality early child care promote low-income children's math and reading achievement in middle childhood?". Child Development, 80(5), 1329-1349. DOI: 10.1111/j.1467-8624.2009.01336.x

Deluca, C. & Hughes, S. (2014). Assessment in early primary education: An empirical study of five school contexts. Journal of Research in Childhood Education, 28 (4), 441–460.

Denervaud, S., Knebel, J.F. & Immordino-Yang, M.H. & Hagmann, P. (2020). Effects of traditional versus Montessori Schooling on 4- to 15-year-old children's performance monitoring". Mind, Brain and Education. 14(2), 167-175.

DeVries, R. & Göncü, A. (1987). Interpersonal relations in four-year olds in Dyads from Constructivist and Montessori Programs". Journal of Applied Developmental Psychology, 8(4), 481-501.

Duckworth, C. (2006). Teaching peace: a dialogue on the Montessori Method. Journal of Peace Education, 3(1), 39-53.

Duffy, B. (1998). Supporting creativity and imagation in the early years. Buckingham: Open University Press.

Elkin, M., Sullivan, A., & Bers, M. U. (2014). Implementing a robotics curriculum in an early childhood Montessori classroom. Journal of Information Technology Education: Innovations in Practice, 13, 153-169.

Ergül, A. (2014). Development of evaluation instrument for the early mathematical reasoning skills. (Unpublished doctoral dissertation), Hacettepe University, Ankara, 2014.

Faryadi, Q. (2017). The application of Montessori Method in learning mathematics: experimental research. Open Access Library Journal, 4, 1-14.

Geary, D. C. (2006). Development of mathematical understanding. In D. Kuhn, R. S. Siegler, W. Damon, & R. M. Lerner (Eds.), Handbook of child psychology: Cognition, perception, and language (pp. 777–810). John Wiley & Sons, Inc.

Gentaz, E. & Richard, S. (2022). The behavioral effects of Montessori pedagogy on children's psychological development and school learning. Children 9(133), 1-11. https://doi.org/10.3390/children9020133

Gomes, R. & Pereira, A. (2014). Influence of age and gender in acquiring social skills in Portuguese preschool education. Psychology, 5 (2), 99-103. DOI: 10.4236/psych.2014.52015

Goss, A.M. (2022). Young children's mathematical spatial reasoning in a Montessori classroom. Unpublished doctoral dissertation). University of Ottowa, Canada.

Hanish, L.D., Xinyue Xiao, S., Means Malouf, L., Lynn Martin, C., Goble, P., Fabes, R.A., DeLay, D. & Bryce, C. (2023). The benefits of buddies: strategically pairing preschoolers with other-gender classmates promotes positive peer interactions. Early Education and Development, 34(5), 1011-1025.

Harris, M. (2005). Montessori Mozart Programme. Montessori International Journal. 75 (17).

Hinkelmann, K. & Kempthorne, O. (2005). Design and analysis of experiments (Volume 2). New York: John Wiley & Sons.

Jin, M. & Moran, M.J. (2021). Chinese and US preschool teachers' beliefs about children's cooperative problem-solving during play. Early Childhood Education Journal. 49, 503–513.

Jin, M. & Moran, M.J. (2023). Preschoolers' cooperative problem-solving during play in Chinese and U.S. classrooms." Early Childhood Education Journal, J 51, 2023: 503–513

Kayılı, G. & Arı, R. (2016). The effect of Montessori Method supported by social skills training program on Turkish kindergarten children's skills of understanding feelings and social problem solving. Journal of Education and Training Studies, 4 (12), 81-91. DOI:10.11114/jets.v4i12.1965

Kilpatrick, W.H. (1914). The Montessori system examined. Boston: Houghton Mifflin Company.

Klein, P.S., Adi-Japha, E. & Hakak-Benizri, S. (2010). Mathematical thinking of kindergarten boys and girls: Similar achievement, different contributing processes. Educational Studies in Mathematics, 73 (3), 233-246.

Lavasani, M.G. & Khandan, F. (2011). The effect of cooperative learning on mathematics anxiety and help seeking behavior. Procedia-Social and Behavioral Sciences, 15, 2011: 271–276.

Laure, M. & Habe, K. (2023). Stimulating the development of rhythmic abilities in preschool children in Montessori kindergartens with music-movement activities: A quasi-experimental study. Early Childhood Educ Journal. https://doi.org/10.1007/s10643-023-01459-x

Leikin, R. & Zaslavsky, O. (1997). Facilitating student interactions in mathematics in a cooperative learning setting. Nationals Council of Teachers of Mathematics, 28(3), 331-354.

Lillard, A. (2007). Montessori: The science behind the genius. New York: Oxford University Press.

Lillard, A. & Else-Quest, N.M. (2006). Evaluating Montessori Education." Science, 313 (5795), 1893-1894.

Lillard, P.P. (1996). Montessori today: a comprehensive approach to education from birth to adulthood. New York: Schocken Books.

Lillard, P.P. (2013). Montessori: A modern approach. (Trans. O. Gündüz). Istanbul: Kaknüs Press.

Lyman, L. & Foyle H.C. (1988). Cooperative learning strategies and children." ERIC DIGEST: 3ED 306003, 1-6.

Lyons, S. (2022). Cooperative Games in Education. NewYork: Teachers College Press.

Macià-Gual, A. & Domingo-Peñafiel, L. (2021). Demands in early childhood education: Montessori pedagogy, prepared environment, and teacher training. International Journal of Research in Education and Science, 7 (1), 144-162. DOI: 10.46328/ijres.1272

Mallet, J.D. & Schroeder, J.L. (2015). Academic achievement outcomes: A comparison of Montessori and non-Montessori public elementary school students. Journal of Elementary Education, 25(1), 39-53.

Manigo, C. & Allison, R. (2017). Does pre-school education matter? Understanding the lived experiences of parents and their perceptions of preschool education." Teacher Educators' Journal, 10, 5-42.

Murtazaevich, M. K. (2020). Development of mathematical abilities in preschool children by the method of design activity. European Journal of Research and Reflection in Educational Sciences. 8 (1), 95-100.

Nachar, N. (2008). The Mann Whitney U: A test for assessing whether two independent samples come from the same distribution. Tutorials in Quantitative Methods for Psychology, 4 (1), 13-20.

National Council of Teachers of Mathematics [NCTM], (2000). Principles and standards for school mathematic. Reston, VA: The National Council of Teachers of Mathematics Inc.

Nisa, T. F., Ariyanto, F.L.T. & Asyhar, A.H. (2019). Montessori learning: understanding the concept of early childhood mathematics. Journal of Physics. 1211 012094.

Rajan, R.S. (2017). Music education in Montessori schools: An exploratory study of school directors' perceptions in the United States. International Journal of Music Education, 35(2), 227-238. https://doi.org/10.1177/0255761416659508

Rambe, N. Syahputra, E. & Elvis, E. (2020). The effect of the Jigsaw Cooperative Learning Model and the student's initial mathematical abilities and its effect on the mathematical representation ability and learning motivation of students in the PAB 10 Sampali Private Elementary School." Budapest International Research and Critics in Linguistics and Education Journal. 3 (3), 1591-1599.

Rathunde, K. & Csikszentmihalyi, M. (2005). The social context of middle school: Teachers, friends and activites in Montessori and traditional school environments. The Elementary School Journal, 106(1), 59-79. DOI:10.1086/496907

Rauscher, F., Shaw, G.L., Levine, L.J., Wright, E.L., Dennis, W.R. & Newcomb, R.L. (1997). Music training causes long-term enhancement of preschool children's spatial–temporal reasoning. Neurological Research, 19 (1), 2-8. DOI: 10.1080/01616412.1997.11740765

Reynolds, A.J. (2004). Research on Early Childhood Interventions in the Confirmatory Mode. Children and Youth Services Review, 26 (1), 15-38.

Sarnecka, B.W. & Gelman, S.A. (2004) Six does not just mean a lot: Pre-schoolers see number words as specific. Cognition, 92 (3), 329-352.

Siew, N.M., Chin, M.K. & Sombuling, A. (2017). The effects of problem-based learning with cooperative learning on pre-schoolers scientific creativity. Journal of Baltic Science Education. 16(1), 100-112.

Siljehag, E. & Allodi, M.W. (2023). Introducing a program supporting social interactions and play in inclusive preschools in Sweden: reflections on a stepwise collaborative implementation process." European Early Childhood Education Research Journal, 31(1), 124-142, DOI: 10.1080/1350293X.2022.2157460

Shatri, Z.G., Bajraj, E., Berisha, R. & Kendusi, V.V. (2021). Didactic tools in the realization of activities in preschool education. Eurasian Conference on Language & Social Science, Gjakova, KOSOVO.

Slot, P.L., Bleses, D. & Jensen, P. (2020). Infants' and toddlers' language, math and socio-emotional development: evidence for reciprocal relations and differential gender and age effects. Frontiers in Psychology, 11, 1-12. DOI:10.3389/fpsyg.2020.580297

Sumpter, L. & Hedefalk, M. (2015). Preschool children's collective mathematical reasoning during free outdoor play. The Journal of Mathematical Behavior, 39, 2015: 1-10. DOI:10.1016/j.jmathb.2015.03.006

Tan, C.K., Harji, M. B., & Lau, S.H. (2011). Fostering positive attitude in probability learning using graphing calculator." Computers&Education, 57(3), 2011-2024.

Tovazzi, A. & Caprara, B. (2019). Montessori approach, math education and gender differences: how can teachers manage pupils' math anxiety?" European Journal of Research on Education and Teaching. 17(1), 193-199.

West, P. (2016). Simple random sampling of individual items in the absence of a sampling frame that lists the individuals." New Zealand Journal of Forestry Science, 46 (1), 1-7.

Whitebread, D. & Coltman, P. (2015). Teaching and Learning in the Early Years." New York: Routledge.