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| Research Article / Araştırma Makalesi |

Examining The Effectiveness of Methods Used In Teaching Basic Mathematical Concepts To Preschool Children*

Okul Öncesi Çocuklarına Temel Matematik Kavramlarının Öğretiminde Kullanılan Yöntemlerin Etkililiğinin İncelenmesi*

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Keywords

1. Boehm preschool basic concepts test-3
2. Concept teaching
3. Mathematics
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Anahtar Kelimeler

1. Boehm okul öncesi temel kavramlar testi-3
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Abstract

Purpose: The aim of this study is to examine the teaching methods that can be used during the instruction of basic mathematical concepts to children in the early childhood period (48-60 months) and to determine which method is the most effective.

Design/Methodology/Approach: The study utilized a quasi-experimental design, which is one of the quantitative research methods. The study sample consisted of 44 children aged 48-60 months who were continuing their education at public kindergartens under the Ministry of National Education (MEB) in Istanbul. The "Boehm Preschool Basic Concepts Test-3 (BÖÖTKT-3)" was used as the data collection tool. Data were analyzed using descriptive and inferential statistics, and the effectiveness of each method was analyzed with a dependent sample t-test. In addition, variances were found to be homogeneously distributed ($p > .05$). Since these assumptions were met, the data were analyzed and compared using ANCOVA.

Findings: The findings from the analyses revealed that the most effective teaching method for teaching basic mathematical concepts in early childhood was the music-based method, among the methods of music-based instruction, drama, and direct instruction.

Highlights: Based on the results obtained from the findings, it is suggested that the music-based teaching method should be actively used in preschool mathematics education in order to increase children's learning outcomes in basic mathematical concepts.

Öz

Çalışmanın amacı: Bu araştırmanın amacı, 48-60 aylık erken çocukluk dönemindeki çocuklara temel matematik kavramlarının öğretimi esnasında kullanılabilecek öğretim yöntemlerinin irdelenmesi, etkili olan yöntemin belirlenmesidir.

Materyal ve Yöntem: Araştırmada nicel araştırma desenlerinden uygun olan yarı deneysel model kullanılmıştır. Çalışmaya İstanbul'da MEB'e bağlı anaokullarında eğitimine devam eden 48-60 aylık 44 çocuk katılmıştır. Araştırmada veri toplama aracı olarak "Boehm Okul Öncesi Temel Kavramlar Testi-3 (BOÖTKT-3)" kullanılmıştır. Veriler betimsel ve kestirimsel istatistik kullanılarak incelenmiş olup her yöntemin etkili olup olmadığı bağımlı örneklem t-testi ile analiz edilmiştir. Bununla beraber varyanslar homojen dağılmıştır ($p>.05$). Bu ön koşullar sağlandığından veriler ANCOVA uygulanarak analiz edilmiş ve karşılaştırılmıştır.

Bulgular: Analizler sonucunda bulunan bulgular neticesinde erken çocukluk döneminde temel matematik kavramlarının öğretiminde müzikle anlatım, drama ve düz anlatım yöntemleri içinden en etkili öğretim yönteminin müzik ile anlatım yöntemi olduğu belirlenmiştir.

Önemli Vurgular: Bulgulardan elde edilen sonuçlar neticesinde çocukların temel matematik kavramlarını öğrenme çıktılarını arttırmak amacıyla, okul öncesi matematik öğretiminde müzikle anlatım yönteminin aktif kullanılması gerektiği düşünülmektedir.

* This study is derived from the first author's master's thesis prepared under the supervision of the second author and presented as an oral presentation at the II. International Dede Korkut Education Research Congress held in Bayburt between 03-05 October 2024.

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INTRODUCTION

Preschool education forms the foundation for all educational levels. In this context, improving the standards of preschool education is seen as a necessity for overall academic success (Avcı & Dere, 2002). It is expected that the correct academic skills taught during the preschool period will lead to children becoming self-disciplined, enterprising, and investigative individuals who can express their emotions, actively use their abilities, and achieve high academic success (Uyanık & Kandır, 2010). Additionally, preschool experience plays a crucial role in children's future competencies, coping skills, health, and later employment (Melhuish et al., 2008).

Children's first encounter with mathematics does not come through formal education (Akman, 2010). From their earliest months, babies start learning mathematics as part of the explorations they must make in the process of becoming a member of the society in which they live (Anthony & Walshaw, 2009). Children initially use fundamental mathematical concepts in their daily activities, such as games they play, sharing with their families, cooking, completing puzzles, counting, estimating distances, and making music. They are then exposed to formal education in schools. The fun and non-threatening nature of the mathematics education they receive during preschool will significantly influence their ability to learn mathematical concepts (İnan & Erkuş, 2019). Basic concepts learned during the preschool period will play a vital role in acquiring fundamental mathematical skills, such as sorting, classifying, comparing, and one-to-one matching, in later stages of learning (Charlesworth & Lind, 2007). The activities and the adequacy of these activities used in teaching these basic mathematical skills are critical for preparing children for primary education (Çelik, 2019).

Preschool teachers have an important role in supporting and enhancing children's mathematical learning by creating motivating learning environments and providing opportunities for children to engage in activities that integrate mathematics into their daily lives (Bourbour & Masoumi, 2017). Teachers who know how, when, and at what level to present concepts can easily plan activities that are appropriate for the children's level and the subject being taught (İnan & Erkuş, 2019). It is crucial to introduce children to as many methods and materials as possible and to allow them to move freely. Limiting math teaching activities to only paper and pencil can reduce children's interactions with the world around them, making mathematical concepts harder and slower to learn (Yazlık & Öngören, 2018). Some mathematical concepts have multiple meanings in different contexts. Teachers need to understand these meanings and assess whether children have learned the intended meaning of the concept through feedback from the child (Dede & Argün, 2004). There is a widespread belief that access to effective mathematics teaching positively impacts preschool children's life chances, and therefore, teachers providing preschool math education should also receive necessary training (Anthony & Walshaw, 2009; Pekince & Avcı, 2016; Gresham & Burleigh, 2018).

According to Vygotsky, children understand words and form concepts in their minds through three main processes:

1. In the first stage, words are found in a disorganized state within the child's mind as a collection of names for separate objects. In both children and adults, words indicating concrete objects have the same meaning, allowing communication between the child and the adult.

2. In the next stage, thinking begins to form with some confusion. At this stage, the child has formed the meaning of words in their mind, but over time, changes occur in the meanings of these words.

3. The final stage in forming concepts is when the child abstracts and recognizes the common and differing features of concepts, abstracting certain features and combining others (Akman, 2010).

As can be understood from this process, when a child develops concepts, they first recognize the word and learn its features. Then, they try to distinguish between words and work to fix the concept in their minds. In the final stage, they define the concept and try to distinguish its similarities and differences from other concepts. From this perspective, it can be said that learning concepts forms the basis of nearly all other learning.

Basic mathematical concepts need to be known to some extent not only in preschool education but also in later stages. Having sufficient knowledge of basic mathematical concepts will help preschool children in learning other math and science topics in kindergarten and elementary school (Unutkan, 2007). Laying a solid foundation for topics they will learn later will greatly benefit children in their primary education.

Interactions that help children acquire new knowledge and skills, receiving verbal responses and feedback from children, will promote participation in learning and make learning enjoyable (Yoshikawa et al., 2013). In this regard, it is important to ensure that activities used in early childhood education are as enjoyable and interactive as possible. When children participate actively in activities, learning becomes more enjoyable, and the hands-on, experiential learning will make it more permanent.

Pre-School Basic Mathematical Concepts

Concepts are used to understand and define the key principles or features of a field and the relationships between different pieces of information in that field (Booth, 2011). A concept is a fundamental unit of all learning. People learn new concepts from

infancy to old age and use old concepts in new situations in their daily lives. Individuals vary in terms of their ability to form concepts, depending on their age, intelligence, and experiences (Manocha & Narang, 2004). For example, the concept of a square for a three-year-old child may differ from that of a high school student.

Learning mathematics is largely related to the development of concepts and is closely connected to the concrete experiences children have (İnan & Erkuş, 2019). For instance, when a child plays with a parent and is asked to give the longest pencil by the parent pointing at it, the child creates an experience. This experience will be very effective in helping the child understand and define the concept of "longest." Similarly, knowing their sibling count, their parent's phone number, the numbers on elevator buttons, and the numbers in hopscotch, all help children develop their sense of numbers through concrete experiences (Ölekli-Sönmez, 2021). A child helping to set the table for the family can be observed using the concept of matching.

It is important to recognize that in preschool children's mathematics education, children's enjoyment of learning and how it makes learning permanent is crucial. Moreover, effective mathematics teaching should involve training that allows children to apply steps of exploration, trial, and discovery (Akman, 2002).

Drama Method of Teaching

Drama is not only a way of learning by doing and experiencing but also a process where individuals benefit from their existing experiences to prepare themselves for new situations and developments (Aytaş, 2013). Drama is an educational tool that requires a high level of creativity. Dramatic activities help individuals better understand themselves and others (Çetingöz & Günhan, 2011). Through dramatic activities, children can discover and develop their own abilities and characteristics.

Some of the most important benefits of using drama in education include: facilitating the healthy expression of emotions, developing children's creative imagination, providing opportunities for independent thinking and self-expression, and increasing social awareness and collaboration (Tombak, 2014). The effective use of the drama method leads to the development of children's language and communication skills, encourages enthusiastic participation in lessons, and enables teachers to convey the intended content more effectively (Aytaş, 2013).

Since drama incorporates many features of play, it encourages children to engage in play as well. Play positively affects children's learning processes, and therefore, the drama method enables children to learn in an enjoyable and effective way (Yalım, 2009).

When used for concept teaching, the drama method fosters active participation, helps children concretize abstract concepts, and allows them to learn through hands-on experience. These qualities create a lasting and effective learning process while ensuring that children enjoy and learn through play (Sezer, 2008).

Music Method of Teaching

It is clear that music is an element that surrounds people in every moment of our lives, something that is always present and brings warmth to us (Kıvılcım & Mertoğlu, 2015). The introduction to music begins with lullabies in infancy and continues as music accompanies almost every part of life, including many memories. Since music is connected to memories, it enhances the permanence of those memories (Torun, 2022). The fact that when a person hears music, they recall a memory, demonstrates how music helps to make memories last. Just as it increases the permanence of memories, music can also be utilized to make learned information more lasting.

The connection between music and mathematics is believed to not only make math learning more enjoyable but also help ensure its lasting nature. Using musical activities during the teaching of many concepts can benefit the education process, as children willingly participate in musical activities, and the positive effects of music on children can enhance their learning experience (Dinçer, 2008).

In his thesis, Karşal (2004) examined the relationship between music and math success in preschool children. The study concluded that children who received music education performed better in mathematics compared to those who did not.

Given the importance of adequately knowing basic math concepts for primary school and later educational stages, Kıvılcım and Mertoğlu (2015) found that the music-based education program applied to early childhood children had a significant effect on their readiness for primary school in terms of math skills.

Direct Instruction Method

The direct instruction method is a teaching approach where the student is passive, and the teacher actively delivers the content, facilitating the acquisition of behavioral knowledge through explanation (Şahin, 2021). Compared to other teaching methods, the direct instruction method allows for the transfer of a large amount of information in a short time and is cost-effective, making it a convenient method that does not incur additional costs.

Due to its ease of use in mathematics lessons, the direct instruction method is frequently employed, but it does not align with the modern structured education approach. It is anticipated that this conventional method may cause difficulties for many students in solving non-routine problems at higher levels (Kablan et al., 2019). Since children are not actively involved, this method may often lead to boredom and distraction (Şahin, 2021). Nevertheless, the direct instruction method can be a useful tool for introducing the lesson, informing students about the objectives, capturing attention, and summarizing the topic at the end of the lesson (Dilci, 2011).

Research Related to the Topic

Ergül (2007), in his thesis titled "Turkish Adaptation of the Boehm Preschool Basic Concepts Test-3 for Children Aged 36-47 Months," examined the basic concept knowledge levels of 36-47 month-old children and conducted a Turkish adaptation of the Boehm Preschool Basic Concepts Test-3.

Çakmak (2012), in his study titled "Investigating the Effect of Concept Education Program in Teaching Basic Concepts to 60-71 Month-Old Children Attending Preschool Institutions," worked with 60-71 month-old children and explored the effectiveness of the concept education program used in teaching basic concepts to children.

Gazaioğlu (2019), in his study titled "Investigating the Basic Concept Knowledge and Problem-Solving Skills of Children Attending Kindergarten," researched the basic concept knowledge of preschool children and examined the impact of basic concept knowledge on their problem-solving skills.

Kırlar (2006), in his thesis titled "Comparative Study on the Effectiveness of Structured and Traditional Methods in Teaching Mathematical Concepts to Six-Year-Old Children in Preschool Education," compared structured education methods with traditional methods. The study found that children taught with traditional methods had lower mathematics achievement scores compared to those taught with structured methods. Kırlar (2006) recommended that mathematics education should be delivered using new-generation structured methods.

Ünal and Kaya (2024), in their study titled "Digital Games in Early Mathematics Education," investigated the benefits of using digital games in early childhood mathematics education. The research emphasized the importance of using interactive activities, where children take an active role, instead of the monotonous direct instruction method, which can make learning boring.

Karşal (2004), in his thesis titled "The Relationship Between Music Ability and Mathematical Ability in Preschool Children and the Effects of Music Education on Mathematics Performance," examined the relationship between music education and mathematics success in preschool children. The study found that children who received music education performed better in mathematics than those who did not. The research highlighted the importance of using music in early childhood mathematics education.

Kıvılcım and Mertoğlu (2015), in their study titled "The Impact of a Music Education Program on Preschool Children's Mathematical Skills and Readiness for Primary School," explored the effects of a music education program on mathematics education. They concluded that the music education program applied to early childhood children had a positive effect on their mathematical skills and readiness for primary school.

The Topic and Problem of the Study

The topic of this research focuses on the methods used for teaching basic mathematical concepts in preschool education. Identifying which of these methods are most effective and recommending their active use in schools is of great importance. In this context, the following sub-problems have been addressed:

- Does the drama-based teaching method have an impact on children's success in learning mathematical concepts?
- Does the direct instruction method influence children's success in learning mathematical concepts?
- Does the music-based teaching method affect children's success in learning mathematical concepts?
- Which of these methods is the most effective in teaching basic mathematical concepts?

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Purpose of the Study

The purpose of this study is to investigate whether music, drama, and direct instruction methods are effective in teaching basic mathematical concepts to children aged 48 to 60 months in preschool institutions, and to determine which of these methods is the most effective.

In the study, three groups of children are taught basic mathematical concepts using different methods: one group with music, one with drama, and the other with direct instruction. Based on this, the hypotheses of the study are as follows:

1. There is a significant difference between the pre-test and post-test scores of children who were taught mathematical concepts using the drama method.
2. There is a significant difference between the pre-test and post-test scores of children who were taught mathematical concepts using the direct instruction method.
3. There is a significant difference between the pre-test and post-test scores of children who were taught mathematical concepts using the music method.
4. There is a significant difference between the post-test scores of children taught mathematical concepts using the drama, direct instruction, and music methods.
5. When the pre-test scores from the Boehm Preschool Basic Concepts Test-3 are controlled, there is a significant difference in favor of the children taught with music in the post-test scores.
6. When the pre-test scores from the Boehm Preschool Basic Concepts Test-3 are controlled, there is a significant difference in favor of the children taught with the drama method in the post-test scores.

Importance and Rationale of the Study

Looking at the research in the literature related to basic mathematical concept knowledge:

Ergül (2007) conducted a study with children aged 36 to 47 months, and Çakmak (2012) worked with children aged 60 to 71 months, while this study focuses on children aged 48 to 60 months. Ergül (2007) investigated the level of concept knowledge in preschool children and found that most of the children exhibited normal development. Çakmak (2012) found that the concept education program they prepared had a positive impact on teaching, and Gazaioğlu (2019) discovered that children's level of basic concept knowledge positively influenced their problem-solving abilities. In this study, examining the effectiveness of the methods used is important because it plays a significant role in concept education for children.

When examining studies in the literature on methods used in early childhood education:

Kırlar (2006) compared traditional education with structured education in early childhood concept teaching and found that structured education was more effective. Ünal and Kaya (2024) argued that digital games are beneficial in early childhood education. Karşal (2004) found that teaching mathematics through music was beneficial, and Kıvılcım and Mertoğlu (2015) showed that a music education program positively impacted mathematical success and school readiness for primary school. This study investigates the effects of music, drama, and direct instruction methods in preschool education to complement and support these existing studies.

Given these findings, it is important to conduct more research on preschool children to achieve effective mathematics teaching. Additionally, there is no other study that examines the effectiveness of the music method, which is underutilized in preschool education, and the drama and direct instruction methods, which are widely used (Göllü, 2018; Yazlık & Öngören, 2018; Okur & Akçay, 2021). Understanding which method is more effective in teaching basic mathematical concepts in preschool education will guide teachers in planning their activities accordingly, making this research significant.

METHOD/MATERIALS

Research Design

Since the children participating in the study were in pre-assigned classes at schools affiliated with the Ministry of National Education (MEB), and random assignment to experimental groups was not possible, the study employed a non-equivalent groups pre-test post-test design, which is a suitable quasi-experimental research model among the quantitative research designs. The quasi-experimental design is frequently used in educational research and is considered a highly appropriate method when it is not possible to control all the variables in the study (Aydede & Matyar, 2009; McMillian & Schumacher, 2010). In this study, since all children attended predetermined classes at their own schools, it was not possible to randomly assign them to experimental and control groups. Therefore, the use of this design was deemed appropriate for the study.

Research Group

The study group for this research consisted of 44 children, including 20 boys and 24 girls, aged 48-60 months, attending public kindergartens under the Ministry of National Education (MEB) in Istanbul. A randomly selected school, which was easily accessible

to the researcher, was chosen, and three 4-year-old classes within the school were used for the study. Each class was treated as a group, and the study was conducted with three groups in total.

Data Collection Tools

For data collection in this study, the "Boehm Preschool Basic Concepts Test-3," adapted into Turkish by Ergül (2007), was chosen. The test is suitable for children aged between 3 years 0 months and 5 years 11 months. The test consists of 76 items. For children aged 3 years 0 months to 3 years 11 months, items 1-52 are applied. For children aged 4 years 0 months to 5 years 11 months, items 25-76 are applied. The information regarding the concepts in the items is provided in Table 1.

Table 1. Item Pairs and Concepts in the BOÖTKT-3

Articles	Concepts	Articles	Concepts
25-39	Nearest	38-52	Biggest
26-40	Finished	53-65	Before
27-41	Smallest	54-66	Most distant
28-42	Across	55-67	At the bottom
29-43	Different	56-68	Shortest
30-44	Longest	57-69	Last
31-45	In front of	58-70	Under
32-46	Both	59-71	Together
33-47	Around	60-72	A little but not much
34-48	Longest	61-73	In the middle
35-49	A lot	62-74	First
36-50	Same	63-75	Between
37-51	Most	64-76	Least

As shown in Table 1, there are two items for examining whether all the concepts are known or not. However, the children's responses to the test items provide a more reliable indication of whether they know the concepts.

The test consists of a manual with pictures of children. On the pages that contain pictures to evaluate all the basic concepts, the child is expected to point to the picture corresponding to the concept asked in the question. Before the picture-based items, which assess the concepts, all children are asked four practice questions to determine if they are capable of taking the test. The responses to these practice items are not included in the final score. To determine whether the children are ready for the test, they must answer all the questions in these four items correctly.

Data Analysis

For the test used in the study, a score of 1 was assigned for a correct answer and a score of 0 for an incorrect answer. The scores for all item pairs were summed up to calculate the total score for each concept. For each concept, there are two items, and the maximum score a child can receive for a concept is 2, while the minimum score is 0. The scores for each concept were summed up, and the total raw score obtained was considered the child's overall score on the test. Children could earn a maximum of 52 points on this test.

During the pre-test and post-test data collection, the entire test was administered to the children; however, only the scores from the four concepts that constituted the content of the training were considered. Since the skewness (0.702) and kurtosis (0.357) values of the data fall within the range of -1 to +1, the data were found to be normally distributed (Hair et al., 2013). The effectiveness of each method was analyzed using a dependent sample t-test. Furthermore, the variances were found to be homogeneously distributed ($p > .05$). Since these assumptions were met, the data were analyzed and compared using ANCOVA.

Implementation Process

Before the data collection process of the study began, the necessary discussions were held with the school, and the school was informed about the process. The required permissions and ethical approvals were obtained from the Ministry of National Education (MEB). The parents of the children were informed about the study, and consent was obtained.

The test was administered individually to each child in a distraction-free and appropriate environment. All children answered the test questions during a process that lasted approximately 15-20 minutes. During the test, no guidance was provided regarding the answers, and no facial expressions or verbal cues indicating whether the answers were correct or incorrect were used. The children's responses were coded as 1 for correct answers and 0 for incorrect answers.

To obtain pre-test and post-test data, the BPBCT-3 was administered to the children. Since the study was conducted with 4-year-old children, only the questions from items 25 to 76 were asked.

A pre-test was administered to the children, and then the descriptive analysis of the scores obtained from the test was conducted. Four concepts, for which the children received low scores, were selected. A total of 12 educational activities were planned to teach these selected concepts using music, drama, and direct instruction methods. The method to be used in each class was randomly determined through a lottery. Classroom teachers were informed in advance not to provide any instruction related to these concepts. Each class received 4 activities over a 4-week period, with 1 activity per week. Examples of the activities are provided in the appendices. After the activities, a 1-week waiting period was observed, and the post-test was conducted.

FINDINGS

In order to answer the research problem, the results of the analysis of the data obtained with the BPBCT-3 are presented in this section.

Children's Concept Knowledge

The percentages of children's knowledge of concepts are shown in Table 2.

Table 2. Findings regarding the percentages of children's knowledge of concepts

Concept Name	Knowledge Percentage (%)	Concept Name	Knowledge Percentage (%)
Nearest	85,24	Biggest	100,00
Finished	97,78	Before	61,83
Smallest	100,00	Most distant	73,17
Across	85,32	At the bottom	96,67
Different	89,77	Shortest	70,43
Longest	91,43	Last	46,86
In front of	72,34	Under	92,90
Both	71,75	Together	69,01
Around	32,98	A little but not much	57,82
Longest	94,44	In the middle	78,89
A lot	98,89	First	72,42
Same	98,89	Between	43,10
Most	97,78	Least	87,54

As seen in **Table 2**, the concepts with the highest knowledge percentages are *'largest'* and *'smallest'* (100%). These concepts are well-known by the children. After *'largest'* and *'smallest'*, the most well-known concepts are *'many'* and *'same'* (98.89%). The least known concept is *'around'* (32.98%). As can be seen in the table, other concepts with lower knowledge percentages include *'between'* (43.10%), *'at the end'* (46.86%), and *'a little but not much'* (57.82%).

Children's Developmental Levels

The interpretation of whether the children's development is normal can be made based on the raw scores they obtained from the test. The total scores obtained by the children and the performance range corresponding to these scores are shown in Table 3.

Table 3. Raw Scores of Children and the Performance Range Corresponding to Them

Performance Ranges	Raw Scores	N	%
1	33-52	41	93,18
2	26-32	3	6,82

When Table 3 is examined, it is observed that the majority of the children who took the test have a good understanding of the concepts. However, it is also noted that only three children in the study are lagging behind their peers.

Findings Related to the Drama Method

Table 4. Results of the Dependent Samples t-Test Analysis of the Pre- and Post-Test Scores of Children Trained with the Drama Method

Test	N	X	s	T	p
Pre-Test	15	4.40	2.20	-3.52	.001
Post-Test		5.60	1.96		

When Table 4 is examined, it is seen that in the dependent groups t-test analysis of the pre-test and post-test scores of children who received education using the drama method, the average score of the pre-test was 4.40, while the average score of the post-test was 5.60. The children's average score increased by 1.20. The results of the dependent samples t-test analysis show that there is a significant difference between the average pre-test and post-test scores, with the post-test scores showing a higher average ($p < .05$). In this case, it can be concluded that the children learned the concepts better after the education with the drama method compared to before the training.

Findings Related to the Direct Instruction Method

Table 5. Results of the Dependent Samples t-Test Analysis of the Pre- and Post-Test Scores of Children Trained with the Direct Instruction Method

Test	N	X	s	T	p
Pre-Test	14	2.93	1.94	-2.5	.04
Post-Test		3.86	2.11		

When Table 5 is examined, it is observed that in the dependent groups t-test analysis of the pre-test and post-test scores of children who received education using the direct instruction method, the average score of the pre-test was 2.93, while the average score of the post-test was 3.86. The children's average score increased by 0.93. The results of the dependent samples t-test analysis show that there is a significant difference between the average pre-test and post-test scores, with the post-test scores showing a higher average ($p < .05$). In this case, it can be concluded that the children learned the concepts better after the education with the direct instruction method compared to before the training.

Findings Related to the Music-Based Teaching Method

Table 6. Results of the Dependent Samples t-Test Analysis of the Pre- and Post-Test Scores of Children Trained with the Music-Based Instruction Method

Test	N	X	s	T	p
Pre-Test	15	3.33	1.76	-7.87	.001
Post-Test		5.53	1.46		

When Table 6 is examined, it is observed that in the dependent groups t-test analysis of the pre-test and post-test scores of children who received education using the music-based instruction method, the average score of the pre-test was 3.33, while the average score of the post-test was 5.53. The children's average score increased by 2.20. The results of the dependent samples t-test analysis show that there is a significant difference between the average pre-test and post-test scores, with the post-test scores showing a higher average ($p < .05$). In this case, it can be concluded that the children learned the concepts much better after the education with the music-based instruction method compared to before the training.

Findings Related to the Comparison of the Methods

The scores obtained by the children from the test have been analyzed, and the ANCOVA analysis findings are presented in Table 7.

Table 7. ANCOVA Analysis Findings

Source	Sum of squares	SD	Mean of squares	F	P	Effect size
Adjusted model	110.07	3	36.69	24.91	.01	.65
Intersection	58.95	1	58.95	40.03	.01	.50
Pre-test	82.14	1	82.14	55.78	.01	.58
Teaching methods	13.84	2	6.92	4.70	.01	.19
Error	58.91	40	1.47			
Total	279.00	44				
Adjusted total	168.98	43				

When Table 7 is examined, it is observed that there is a significant relationship between the children's mathematics concept knowledge levels before the education and their mathematics concept knowledge levels after the education ($p < .05$). When the pre-test scores of the methods used are controlled, it has been determined that they have a significant effect on the children's mathematics concept knowledge levels after the education ($F = 4.70$, $p < .05$, $r = .19$).

Regarding the research sub-question of which method is more effective, the ANCOVA analysis can be interpreted by controlling the pre-test scores and using the average post-test scores. These values are provided in Table 8.

Table 8. Post-Test Averages When Pre-Test Scores Are Controlled

Methods	$\bar{X}$	SE
Drama	5.00	.32
Music	5.70	.31
Direct Instruction	4.32	.33

* Pre-test means = 3,57

When the averages are examined, it is observed that the group trained with the music-based instruction method has the highest average, suggesting that this method is the most effective. On the other hand, due to the lowest average in the group trained with the direct instruction method, it can be concluded that this method is the least effective.

DISCUSSION AND CONCLUSION

In the study, subheadings such as the percentage of 48-60 month old children who continue their education in preschool education institutions knowing basic mathematical concepts, their developmental levels and which of the methods used in teaching basic mathematical concepts has a greater effect than others were examined.

When children's basic mathematical concept knowledge is examined, it is seen that they know most of the concepts. It has been determined that the least known concept is the concept of perimeter, and it has been observed that this concept is not emphasized in the preschool curriculum. It can be said that this situation is quite effective in the fact that the concept is so little known. Although most children encounter this concept in their daily lives, they do not know the visual meaning of the concept. It is thought that not teaching this concept in the preschool period will cause children to have difficulty in finding the perimeter lengths and areas of polygons in the later stages, and to confuse the perimeter and area formulas.

It has been observed that most of the children's developmental levels are progressing as they should, and accordingly, it can be said that they actively participate in the training and can focus better.

When we look at the applied education, it is seen that children can learn concepts to a certain extent as a result of all methods. As a result of the analysis, it is seen that the method that shows the least effect is the direct narration method. Since the direct narration method makes learning boring not only in preschool education level but also in most education levels, it should be preferred less. Since children need to participate more actively in education in order for their concentration period to be extended, the direct narration method reduces the concentration period due to children not being able to actively participate. The efficiency that children get from education decreases with the decrease in the concentration period.

Ünal and Kaya (2024) also defended the importance of using more entertaining and interactive activities in which children play an active role instead of using boring plain narrative methods in the education of preschool children in their study investigating digital games in early childhood education. Since children have a task to do in interactive activities, they follow the education more carefully and try to do their duty. For this reason, care should be taken not to let children remain passive in education in order to increase focus.

Kırlar (2006) made a comparison of the structured and traditional preschool methods in his thesis. It was determined that the scores of children who received education with the traditional method were lower than the scores of children who received education with the structured method. Considering this situation, it was recommended that preschool mathematics education be given together with methods such as music, games and drama.

As a result of the analysis, it was seen that the method of narration with drama was quite effective in teaching basic mathematical concepts in preschool. In order for the method to be more useful, children may need to be informed about what drama is and how it is done. Drama is a teaching method that is both difficult to apply for both the teacher and the child, but also enjoyable. Although this method is effective, it is difficult to apply for every concept.

Since many sensory organs are actively used in drama studies, it can be said that it positively affects other developmental areas, including cognitive development (Başdemir, 2024). It is very important for a method to appeal to more than one area. In this way, while the teacher's aim in doing the activity is to teach a concept, it also benefits the child in several different developmental areas such as social and cognitive.

In Kanak and Pekdoğan (2018) stated in their research that preschool teachers generally prefer the direct instruction method because they see themselves as inadequate. Similarly, this research draws attention to the fact that preschool teachers should use methods other than direct instruction in their lessons. Gresham and Burleigh (2018) also point out that preschool teachers should use structured education, but that they should receive adequate training in this regard. It is mentioned that as teachers receive training in the use of various methods, they will be able to apply those methods to children more easily and correctly, and thus prefer them more.

It is very important for preschool teachers to have materials that will support children's academic skills and to organize activities in a way that children will actively participate. It will be beneficial if the environment is suitable for the activity, as it will increase the efficiency of the activity and the teacher's desire to do the activity will increase when the material is easily accessible. This situation was also stated by Uyanık and Kandır (2010) in their study.

In their study, Bilgin (2024) stated that preschool teachers think that children learn more easily when they have fun while teaching mathematics to preschool children. It was also mentioned that children who have difficulty learning are taught concretely with materials or games they like. It is also very important for teachers to realize that some children learn mathematics with different methods and to determine suitable methods for these children and organize education for them. The fact that this study supports the results and the importance of having a variety of activities is seen in the feedback collected from the teachers in the study results.

It has been observed that the method of narration with music is the most effective teaching method in teaching basic mathematical concepts to children aged 48-60 months. These activities take into account the learning differences of children in terms of appealing to more than one sense organ, and they are very entertaining and actively participated by children. Since there is no need for a method education like the method of narration with drama, almost every child can be actively involved in the education. It is also a very easy method for teachers to use in terms of designing activities for almost every concept.

Another study that will confirm the results of this study is Karşal's (2004) thesis examining the relationship between music and mathematics achievement in the preschool period. As a result of the study, it was seen that children who received music education were more successful in mathematics than children who did not, and the importance of using music was emphasized. Another study conducted by Kıvılcım and Mertoğlu (2015) examined the effect of the music education program applied to early childhood children on their readiness for primary school in terms of mathematics skills, and similar results were reached, again emphasizing that the inclusion of music in mathematics education would yield positive results. Similarly, Whitehead (2001) stated in his study that the use of music in teaching mathematics positively affected academic achievement.

In the study conducted by Günaydın et al. (2023), although they worked with different samples and four methods, similar results were obtained. In the study, it was seen that the narration method with music and drama was quite effective in teaching basic mathematics concepts in pre-school. It was mentioned that the direct narration method should be preferred less because it causes distraction in children and has little benefit in effective teaching, and teachers should prepare their activities using music and drama methods, which are very beneficial in effective teaching of basic mathematics concepts in pre-school.

RECOMMENDATIONS

Suggestions for Researchers:

In this study, drama, music, and direct instruction methods were examined, and researchers may be encouraged to compare additional methods. While looking at research on the most and least commonly used teaching methods in preschool mathematics education, there was a lack of sufficient information. Therefore, conducting further studies in this area is also recommended.

Suggestions for Preschool Teachers:

Preschool teachers are advised to avoid using the direct instruction method when planning their activities and to instead focus on methods like drama and music that encourage active participation from children. As seen in the results of this study, music-based teaching is very effective. Therefore, even when using a different method, it is recommended that teachers incorporate the concept being taught into a song or musical activity to enhance the lesson.

Declaration of Conflicting Interests

The authors declare that there is no conflict of interest with any institution or person within the scope of the study.

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Statements of publication ethics

We hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Examples of author contribution statements

N.G. and B.K.D. conceived of the presented idea. N.G. developed the theory and performed the computations. B.K.D verified the analytical methods. B.K.D. encouraged N.G. to investigate [a specific aspect] and supervised the findings of this work. All authors discussed the results and contributed to the final manuscript.

Researchers' contribution rate

The authors contributed equally to all processes of the article. The authors have read and approved the final version of the article.

Ethics Committee Approval Information

The ethics committee document of this study was approved by the ethics committee decision of Bayburt University Rectorate dated 23.05.2022 and numbered 70389.

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