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# Teaching the development of mathematical symbols to preschool children

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*Abstract*

*Teaching the formation of mathematical symbols for children emphasizes that educating and guiding children in mathematics from an early age is very important to help them develop logical thinking, creativity, and problem-solving skills. The research results have presented how teachers can apply the method of learning through games and practical activities to help children understand and form mathematical symbols naturally and effectively. Mathematics education for children is not just about learning formulas or memorizing concepts, but it needs to help children understand and form mathematical symbols in their minds naturally and flexibly. At the same time, the application of learning methods through games and practical activities will help children approach mathematics in an interesting and non-boring way, thereby arousing their passion and love for this subject. The study was conducted on 515 children aged 4-5 years. This research highlights the importance of early mathematics education and the use of innovative teaching methods to engage young children and help them develop fundamental mathematical skills. By creating a fun and stimulating learning environment, children can develop an interest in mathematics that will stay with them throughout their academic careers.*

*Keywords: Mathematical symbols; Preschool children; Methods; Teaching.*

## Introduction

Preschoolers are the first target in the process of education and intellectual development. However, teaching math to preschoolers often encounters many difficulties. In recent years, many studies have focused on researching and developing appropriate teaching methods

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for preschoolers to develop math calculation skills and mathematical symbols.

This research addresses the problem of "Teaching the Development of Mathematical Symbols for Preschoolers". We have developed methods and tools used in teaching math to preschoolers, including using educational toys and games, images and videos, group activities, music and singing, and using real objects.

At the same time, the study has provided new insights into teaching math to preschoolers, helping educators and parents have more effective methods and tools to help children develop math calculation skills and mathematical symbols from an early age. The research results in this article can provide useful information for educational managers and education researchers to improve preschoolers' education quality.

## Literature review

Developing mathematical symbols for preschoolers is a topic of great interest in the field of education. Clements, D. H., & Sarama, J. (2007) provide an overview of current research on mathematics education for young children, including the development of the meaning of numbers, the importance of play in learning mathematics, and effective teaching strategies for young children. Gelman and Gallistel (1978), and Nguyen Van Minh (2018) studied how children develop counting skills. The results of the study showed that using images, graphics, and symbhelpshelp children develop counting and basic mathematical concepts. Baroody's (1998) research focused on studying methods of teaching mathematics to preschoolers, such as using real-life math activities, using toys to teach math, and helping children develop the ability to represent mathematics.

Baroody and Diamond (2016) studied the impact of using geometric toys and paper-based activities on the development of the counting and calculation skills of preschool children. Wood's (2012) research focused on using creative math activities to help children develop their ability to represent and process mathematical information. The results showed that using creative math activities helps children develop their ability to represent mathematics and learn math positively. Clements and Sarama (2008), and Nguyen Thi Hang (2017) focused on applying a positive math teaching program for preschoolers. They believed that using creative and highly interactive math activities between teachers and children helps children develop their ability to represent and process mathematical information better. Clements and Sarama (2014) proposed using teaching methods based on games and real-life activities to help preschoolers develop their math skills. Clements and

Sarama (2018) clarified the impact of using technology in teaching math to preschoolers. Ramani (2016), and Kim (2020) studied the impact of using stories and images in teaching math to preschoolers. In a different approach, Ramani and Siegler (2018) investigated the role of different types of math teaching, including symbolic math teaching, in promoting math learning in preschoolers. Richardson (2017) and Le Thi Hong Tham (2014) researched to evaluate the effectiveness of using visualization techniques and real-life objects to teach mathematics to preschool children.

Nguyen (2015) investigated the relationship between counting ability and mathematical symbol understanding in preschool children. Hornburg and Lampert (2011) examined the effectiveness of a math pre-teaching program that included instruction on math symbols for kindergarten students. Starkey and Klein (2013) investigated the relationship between children's early number understanding and later math achievement. Gillanders and Johnson (2019) explored the impact of math intervention measures, including symbol instruction, on math achievement in preschool children.

Klibanoff (2006), Morris (2016), Johnson (2019), and Phan Thi Thu Huyen (2016) investigated the influence of using tools, music, and object models to teach math to preschool children. Lee (2017), Blevins-Knabe (2018), and Nguyen Thi Hong Nhung (2019) examined the impact of using math toys to teach mathematical symbols to preschool children.

Author Ann Montague-Smith [92] also studied activities for developing math symbols based on initial learning goals for children under 5 years old, such as counting the number of edges in a shape, the surface area of a block, connecting shapes, comparing, and classifying geometric shapes, as well as the idea of planning, assessing, and recording. The author provided specific activities to help children become proficient in recognizing geometric shapes and comparing them to one another.

Also studying the formation of math symbols for preschool children, the National Education Council of the United States believes that math problems have only one answer but there are many ways to arrive at the answer. When forming math symbols for children, it is important not only to find the correct answer but also to the process of problem-solving and applying what the child has learned to new problems. According to them, incorrect answers can also be useful. Accuracy is always important in mathematics. However, sometimes teachers can use incorrect answers to help children identify their mistakes. Analyzing incorrect answers helps children understand the concepts underlying the problem and helps them develop reasoning skills to arrive at the correct answer. Ask the child to explain how they solved the problem. Encourage risk-taking in children, show them the value

of problem-solving, and give them time to explore different methods to solve difficult problems. Encourage children to talk about what they are thinking. This helps children strengthen their math skills in general and shape symbol recognition in particular to become independent thinkers.

Douglas Frye et al, in their study on the formation of mathematical symbols for children, focused on teaching children to observe and describe the world around them using geometric shapes to transition from passively recognizing geometric shapes to actively using mathematical language. According to the authors, teachers need to use open-ended questions to stimulate children's thinking and describe their ideas using mathematical methods and increase mathematical conversations in the classroom. They believe that if a child can describe how they solved a problem to another child and then listen to the other child describe their problem-solving approach, all children will learn how to apply mathematical knowledge in new ways.

In her study, A. M. Leusia outlined the laws of development, and the stages of shape symbol development, and also analyzed and clarified the early appearance of shape comparison ability in children aged 2-3, which is further developed under the influence of adult teaching. Children can perform practical measures to compare the shapes of objects by examining those objects and expressing the relationships between shapes using words. Based on this, the author proposed content and some methods of teaching children to compare the shapes of objects.

These studies all focus on researching and developing appropriate teaching methods to develop math skills and mathematical symbols for preschool children and provide valuable results for teaching math to preschool children.

Mathematical symbols that should be formed for preschool children

Mathematical symbols that should be formed for preschool children include numeral symbols, shape symbols, size symbols, spatial orientation symbols, and temporal orientation symbols. These mathematical symbols are identified as important prerequisites for children to continue learning mathematics in higher grades, including numbers and operations, geometry and measurement, and probability and statistics. Specifically:

Numbers (0-10): The numerals 0-10 are the most basic mathematical symbols and should be introduced to preschoolers as early as possible. Children can learn to recognize the shapes of the numerals and associate them with the corresponding number words.

Plus (+) and Minus (-) Signs: The plus and minus signs are the simplest symbols for addition and subtraction respectively. Preschoolers can learn to associate the plus sign with "adding" and the minus sign with "subtracting".

Equal (=) Sign: The equal sign represents "is the same as" and can be introduced to preschoolers when they are ready to begin exploring basic equations. For example, 2 + 3 = 5.

Greater Than (>) and Less Than (<) Signs: These symbols represent "more than" and "less than" respectively. Preschoolers can learn to recognize the shapes of these symbols and understand their meanings in simple comparisons, such as "3 is greater than 2" or "5 is less than 6".

Shapes: Basic shapes such as circles, squares, triangles, and rectangles can be introduced to preschoolers as part of their early math education. They can learn to recognize and compare these shapes, as well as learn basic concepts such as symmetry and spatial reasoning.

## Research Methodology

Observational study: An observational study involves observing preschool students in their natural environment (e.g. classroom) and recording their interactions with mathematical symbols. Researchers can use this method to understand how students interact with symbols and how teachers use symbols to teach math. Case study: A case study involves an in-depth analysis of individual preschool students or a class. Researchers can use this method to gain a detailed understanding of how mathematical symbols are taught and learned in specific contexts. Interviews and surveys: Interviews and surveys involve direct data collection from teachers, parents, and preschool students. Researchers can use this method to gain a better understanding of teachers' and parents' beliefs and practices related to mathematical symbols, as well as students' experiences with symbols. Experimental study: An experimental study involves manipulating one or more variables and measuring their impact on a group of preschool students. Researchers can use this method to test the effectiveness of different teaching methods or interventions aimed at developing mathematical symbols. Mixed-methods study: A mixed-methods study involves using more than one research method to collect and analyze data. For example, a researcher might use observational studies to collect data on how preschool students interact with mathematical symbols, and then use surveys to collect data on teachers' and parents' beliefs and practices related to math education. The research was experimentally conducted on 515 preschoolers in Hanoi during the 2021-2022 academic year. The

evaluation results are categorized into four levels: excellent (9-10 points), good (7-8 points), fair (5-6 points), and poor (below 5 points).

## Research Results and Discussion

The process of designing a scoring scale to assess the level of mathematical symbol formation in preschool children includes the following steps:

Identifying the structure: The formation of mathematical symbols refers to a child's ability to recognize and write numbers and other mathematical symbols, such as plus and minus signs, equal signs, and geometric shapes.

Developing a list of items: Create a list of items that will measure the structure of mathematical symbol formation. For example, items may include asking children to identify numbers or geometric shapes, asking them to write numbers or geometric shapes, or asking them to complete simple addition or subtraction problems.

Determining the scoring system: Decide how each item will be scored. For example, correctly identifying or writing a number or symbol may be scored 1 point, while incorrect or incomplete answers may be scored 0 points.

Establishing the range of the scale: Determine the range of scores for the scale. For example, the scale may range from 0 to 20, with higher scores indicating a higher level of mathematical symbol formation.

Piloting the scale: Administer the items to a small group of preschool children to test the clarity and effectiveness of the items and scoring system.

Adjusting the scale: Based on feedback from the test group, revise the items and scoring system as necessary.

Managing the scale: Manage the final version of the scale for a larger group of preschool children to collect data on their level of mathematical symbol formation.

Analyzing the data: Analyze the data to determine the reliability and validity of the scale. This may involve calculating measures of internal consistency, test-retest reliability, and criterion-related validity.

Using the scale: Once the scale has been refined and validated, it can be used to assess the level of mathematical symbol formation in preschool children and monitor their progress over time.

Building a scale to assess the level of formation of mathematical symbols

It is important to note that for preschool children, learning should be interactive and fun. Mathematical symbols can be incorporated into games, puzzles, and other fun activities to help children develop math skills engagingly and interestingly.

The following is a feasible scale for assessing the level of formation of mathematical symbols for preschoolers:

Level 1 - Recognition: The child can recognize and identify the symbol when it is displayed.

Level 2 - Association: The child can associate the symbol with its corresponding concept or meaning. For example, the child can associate the plus sign with "addiction" or the number 3 with a group of three objects.

Level 3 - Application: The child can use the symbol to solve basic math problems or tasks. For example, the child can add two quantities together using the plus sign or use greater than and less than signs to compare quantities.

Level 4 - Expansion: The child can expand their understanding of the symbol to more complex concepts or contexts. For example, the child can use the equals sign to solve equations with variables or use shapes to create patterns and designs.

This scale is flexible and adaptable to the learning pace and ability of each child. It is important to note that preschool children may progress at different levels and may not reach Level 4 for all symbols in their preschool years. The goal is to provide a solid foundation for future math learning by gradually building an understanding and application of these basic symbols.

Some methods applied in teaching to develop mathematical symbols for preschoolers

Using educational toys and games: This is one of the most common methods to teach math to preschoolers. Educational toys and games can help preschoolers understand mathematical symbols and develop basic calculation skills.

Using images and videos: Using images and videos helps preschoolers visualize and understand mathematical concepts. Image and video materials can help preschoolers learn mathematical symbols and develop basic calculation skills.

Organizing group activities: Group activities help preschoolers learn from each other and develop social skills. Learning math through group activities also helps preschoolers understand mathematical concepts more clearly.

Using music and singing: Using music and singing helps preschoolers learn mathematical symbols in a fun way. By signing math-themed songs, preschoolers can learn basic calculations and develop reasoning skills.

Using real-life objects: Using real-life objects helps preschoolers connect mathematical concepts with reality. For example, using apples to teach calculations helps preschoolers understand concepts such as quantity and addition.

Research on teaching the development of mathematical symbols for preschoolers has suggested many teaching methods suitable for the age and level of preschoolers, helping them develop calculation skills and understand mathematical symbols in the best way.

These methods have been applied in teaching math to preschoolers and have achieved positive results. For example, using toys and real-life objects in teaching has helped preschoolers understand mathematical symbols more easily. Using images and videos helps preschoolers understand concepts more visually and vividly, thereby helping preschoolers develop calculation skills. Using group activities in teaching helps preschoolers improve communication skills and learn from peers, thereby helping preschoolers improve their understanding of mathematical symbols. Using music and singing helps preschoolers have more fun when learning math and helps preschoolers remember mathematical symbols more easily.

Experiment with using toys in teaching to form mathematical symbols for preschool children.

Developing a process for using toys and real objects in teaching is one of the methods that have been researched and applied to help preschool children understand mathematical symbols more easily. The process can be described as follows:

Step 1: Select appropriate toys and real objects according to the age and level of preschool children. For example, for children aged 3 to 4 years old, toys such as candy, balls, wheels, fruit, puzzle toys, etc. can be selected.

Step 2: Choose a mathematical symbol to teach, such as quantity, addition, or subtraction.

Step 3: Allow preschool children to participate in activities using toys and real objects to help them understand mathematical symbols. For example, have preschool children stack candy on circular toys to help them understand the concept of quantity and geometry; have them perform addition by adding balls to wheel toys; or have them perform subtraction by dividing fruit into smaller parts.

Step 4: Explain to preschool children the meaning of the mathematical symbol they have learned through the activities using toys and real objects. For example, explain to preschool children that addition is the process of adding quantities or objects together to create a new total quantity or object.

**Table 1: Experimental results form 4 levels of mathematical symbols for children**

| Levels | Degree evaluation | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Good | | Fair | | Average | | Poor | |
| | number of people | Percentage % | number of people | Percentage % | number of people | Percentage % | number of people | Percentage % |
| Level 1 | 279 | 54.2 | 185 | 35.9 | 51 | 9.9 | 0 | 0 |
| Level 2 | 258 | 50.1 | 203 | 39.4 | 54 | 10.5 | 0 | 0 |
| Level 3 | 217 | 42.1 | 211 | 40.9 | 87 | 17 | 0 | 0 |
| Level 4 | 197 | 38.2 | 235 | 45.6 | 83 | 16.2 | 0 | 0 |

In this chart, the level of mathematical symbol formation is divided into 4 levels: poor, fair, good, and excellent. Based on the experimental results, no student was classified as poor. The percentage of children achieving fair and good levels in all 4 levels is over 80%. The percentage of children achieving the average level ranges from 9.9% to 17%. The survey results show that applying game-based methods in teaching mathematical symbol formation to young children is highly effective.

From this process, it can be seen that using toys and real-life objects in teaching is a highly effective method to help preschoolers understand mathematical symbols more easily. However, it is necessary to choose toys and objects that are suitable for the target symbols to be formed and developed for children.

Discussion

Some studies also show that combining the use of toys and real-life objects with methods aimed at exploring and self-learning of children has helped preschoolers develop mathematical skills more effectively. In addition, studies also provide advice on using appropriate teaching methods and materials that are suitable for the age and ability of children, helping them be interested and creative in the learning process.

However, it should be noted that teaching mathematical symbol formation to preschoolers is a complex process that requires the effort and expertise of teachers. To achieve the highest effectiveness, it is necessary to combine teaching methods that are appropriate for the

characteristics of preschoolers, along with the active participation of families and the community.

A study published in the Journal of Experimental Child Psychology (Kuhn & Siegler, 1999) examined the development of mathematical symbols in preschool children aged 3-5 years old. The researchers found that children were able to recognize and identify basic numbers and shapes, such as squares and triangles, at a young age. However, it took children more time to understand concepts such as addition and subtraction and to use symbols such as the plus and minus signs.

Another study published in the Journal of Childhood Education (Brenneman & Kasmer, 2013) explored the use of games and game-based activities to teach mathematical symbols to preschool children. The researchers found that using interactive games and hands-on activities, such as building blocks and puzzles, helped children develop a deeper understanding of mathematical symbols and concepts.

Fisher's study (2016), published in the Journal of Educational Psychology, examined the effectiveness of different teaching methods in developing mathematical symbols in preschool children. The researchers found that using a combination of visual and verbal cues, such as showing pictures and repeating number words, was the most effective method for teaching basic mathematical symbols to preschool children.

In general, these experimental results indicate that preschoolers are capable of learning and understanding basic mathematical symbols with appropriate teaching methods and materials. Interactive games and hands-on activities can be particularly effective in helping children develop mathematical skills, and a combination of visual and verbal cues may be the most effective teaching method. However, it is important to note that each child's learning speed and ability may vary, and it is crucial to provide a supportive and engaging learning environment for all preschoolers.

## Conclusion

Mathematics education for children is not simply about learning formulas or concepts, but also about helping them understand and develop mathematical symbols naturally and flexibly. Additionally, the use of game-based and hands-on learning methods can make math more interesting and less tedious for children, thereby igniting their passion and interest in this subject. The formation of mathematical symbols for children is an important factor in mathematics education for preschoolers. Game-based and hands-on learning methods also

play an important role in helping children approach mathematics enjoyably and effectively.

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