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Research Article

COGNITIVE PSYCHOLOGY BASIS ON THE FORMATION OF MATHEMATICAL SYMBOLS FOR PRESCHOOLERS

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ABSTRACT

This article mentioned the psychological basis for the formation of mathematical symbols for preschoolers. The result indicated that psychology was the basis for the formation of mathematical symbols for preschoolers such as quantity, number, numeration, space, time, shape, and size. However, at each age of preschool, the content, form, and method of formation were different with various requirements based on the physiological development of children and suitability with developmental characteristics of each child. It also proved that the appropriate impact orientation such as interdisciplinary integration in preschool education will enhance effectiveness for caring and educating children.

Keywords: math; preschoolers; psychology; symbol integration

1. Introduction

Preschool education is the first level of the national education system as a foundation for the physical, cognitive, social, and aesthetic development of children. The skills that the children acquire through preschool education will be the foundation for their later study and success. Therefore, the development of preschool education and increase of children's learning readiness play important roles in developing high-quality human resources for a nation.

Psychology is the science that studies human psychological phenomena: psychological processes, psychological states, psychological attributes; at the same time research the origin, mechanism, motivation, factors affecting human psychological development.

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Psychology has a close relationship with many sciences such as philosophy, sociology, literature, religion, art, education, and mathematics.

Formation of mathematical symbols for preschoolers is one of the subjects in the preschools. Therefore, in education schools, the formation of basic mathematical symbols for preschoolers was a professional subject belonging to a specialized program (Nguyen, 1999). It played an important role to contribute to the achievement of training objectives in the schools. The formation of mathematical symbols for preschoolers had a special position in intellectual education for preschoolers as a foundation for the development of thinking and cognitive capacity, which contributed to the comprehensive development of personality and provides children with basic math symbols, skills such as distinction, comparison, classification, synthesis, generalization, and abstraction before grade 1 (Dinh, 2004).

Particularly for mathematics for preschoolers, psychology is very important in the formation of basic mathematical symbols based on the process of feeling, perception, memory, thinking, and imagination of human psychology. Through the process of the direct or indirect impact of reality, mathematical symbols of preschoolers are formed and developed (Dao, 2004).

2. The relationship between psychology and the formation of mathematical symbols for preschoolers

Perception is believed to be the process of dynamically and creatively reflecting reality into the human brain. Thanks to cognitive activities, not only the outside but also the inner nature, the regular relationships govern the movement and development of things and phenomena, not only reflecting the present but also the present. What has passed and what is to come. This activity includes many different processes that exhibit different levels of reflection of objective reality and yield different products of objective reality.

The method of forming mathematical symbols is how teachers guide children to become acquainted with and perceive and understand mathematical symbols. The method for the formation of mathematical symbols must rely on achievements of preschool psychology, especially on characteristics of the processes of sensation, perception, memory, and thinking for preschoolers. In particular, it is especially important to master preschoolers's form of thinking to apply and bring effectiveness in teaching. Based on rules of perceiving basic mathematical symbols of children by age, we determine the amount of knowledge, level, and the requirements for behavior and thinking in children at each group of age for purpose of organizing and controlling the process of perceiving the mathematical knowledge in each different lesson and activity of children in the preschool (Dao, 1996).

Characteristics of preschoolers emotion-based awareness, visual thinking, and characteristics for the formation of mathematical symbols are that children perceive through activities under organization and instruction and assessment of the teacher. Therefore, for

each symbol, children begin with recognizing, calling its names based on external signs, and then identify specific signs of each symbol through comparison, analysis, and generalization (Dao, 2004).

When the symbols have been formed, children apply to practice and compare with the surrounding reality.

For example: In order to form a square symbol for children at the age of 3-4 years, the teacher asks them to select a picture according to the model, name the picture and select the picture by the name. At the age of 4-5 years, the teacher let children survey the model by touching its contour and rolling it so that they can find that the square has a straight and non-rolling contour. Then the teacher asks the children to arrange the stick into a square and through it, the children count the number of sticks and compare their length, thereby, children can recognize that the square is made of four sticks with equal length.

Help children to recognize the shape of a square with other materials so that they have a fuller and more general sense of the square symbol: "A square is a shape with four equal-long edges".

That fact indicates that the formation of mathematical symbols for preschoolers contributes to the formation and development of cognitive capacity for children, thereby helping them to move from visual thinking to logical thinking. By that, the children can perceive the surrounding world and find the relationship between mathematical symbols and the surrounding world.

For example, rectangular symbols help children to recognize paper, desks, and windows, which are different objects and in the form of a rectangle.

Contribute to the formation and training of thinking manipulations: comparison, analysis, synthesis, and generalization. Contribute to language development for preschoolers: Due to limited knowledge, poor language, children are unable to understand the meanings of mathematical language, so they often say it incorrectly. Therefore, for the formation of mathematical symbols, in addition to helping children say it right and make sense, it is important to provide children with vocabulary for mathematical symbols so that they can understand and express such words in line with reality, contribute to the development and promotion of psychological processes for children such as memory, attention, and imagination.

The cognitive characteristics of preschoolers are emotion-based awareness, visual thinking. So, children recognize basic mathematical symbols through activities and support of senses: eyes to see, ear to hear, hands to touch, mouth to say words to comment and explain. Through senses, children are mobilized to identify, try, compare, and distinguish. Because of young age, limited exposure to the surrounding environment, poor language,

weak ability of synthesis, mainly sensory awareness, the accuracy is limited. The children's recognition of mathematical symbols is also influenced by colors, shapes, especially the size and arrangement of objects in space (Nguyen, 2010).

For example, when comparing the number of three oranges and five dots, a child can comment that the number of oranges is much more than the number of dots.

Perceptual ability to draw comments and present into symbols depends on experience and age. The older the children are, the greater the ability of generalization is, so the instruction of teacher is very necessary for the formation of basic mathematical symbols for preschoolers to help them draw general comments and know how to express correctly,. several researchers have shown that children are capable of recognizing some mathematical symbols and need to form some of them right at the age of preschool.

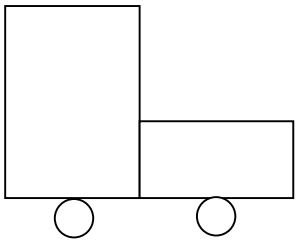
Some mathematic symbols can be formed in children very early. For example, whena 4-5 months-old baby is crying, they will stop crying when hearing the mother's voice, and tilts his/her head towards that voice. When a 3-4 years-old child sees an adult holding a bag of candy and giving them 2-3 pieces, he/she does not receive and asks the whole bag, because he/she understands that the whole bag has more than 2-3 pieces. Or when they eat or wear shoes, they know that they need to find teo chopsticks and two shoes even though they are not in the same pair. This indicates that they have understandings of math very early, but all of them come from the natural reflex of the body or imitating adults. It is the result of direct perception of the children through daily activities, but the thorough, solid, and systematic understanding of these concepts is not available (Nguyen, 2008).

On the other hand, due to limited exposure to the surrounding environment, poor language, limited understanding, the children are unable to understand the meaning of mathematical words and express them correctly. For example, if there are three cakes and six candies, children often say "the number of cakes is much more than a number of candies". The children here referred to "more" in size, not in quantity. When comparing two strings, two trees, instead of saying "green string is longer than the red one, the yellow tree is higher than white one", the children often said "green string is bigger than the red one, the yellow tree is bigger than white one", etc.

The above examples show that the knowledge and experience of children themselves cannot help them understand and express properly mathematical symbols. Therefore, the formation of mathematical symbols for preschoolers is very necessary.

It helps children: 1. Handle some difficulties in daily life, help children become familiar with the world around them, be aware of attributes and characteristics of objects around them.

For example, looking at the picture of a car, the child recognizes that the car front and its trunk are rectangular, the wheels are circular.



Through surveying the contours of the shapes and rolling them, the child knows: wheels, car wheels, train wheels must be circular to roll.

When you need to form a square, instead of using any sticks to do, if unsuccessful, you will choose another stick to form until you get a square, you can choose 4 sticks with equal length to form a square.

The formation of mathematical symbols also helps children express accurately, completely, and concisely their desired thoughts. Therefore, when the teacher asks how many people are there in your family?, instead of calling the names of each member in turn, it is simply that my family has 4 people – A concise and correct answer for the question. On the other hand, children learn other subjects more easily, understand them better, and expand their understanding of relationships in their surroundings with some mathematical symbols (Nguyen, 1994).

Through the issues d above, we find that the world around children is the origin of mathematical symbols formed for them.

3. The content of forming mathematical symbols for preschoolers based on psychology

3.1. Symbol about collection in preschoolers

- **Perceptual characteristics in preschoolers**

+ Little preschoolers (3-4 years old)

- At three years of age, children understand and distinguish correctly some words such as “one, few, much” and know how to apply that knowledge into real life.

- Under 3 years old, the children are familiar with “collection” of toys, dolls, flowers, cakes...

- The children who are in the range of 3-4 years old are capable of recognizing the collection as a complete set, but the children cannot imagine all elements of a collection as well as each element.

+ Average preschoolers (4-5 years old)

- For children at the age of 4-5 years, their collective symbols are developed and expanded, and they are capable of recognizing collection even when their elements are not the same. For example, a collection of geometric figures consisting of different shapes, or a basket of balls in blue and red. This proves the children have a development in the ability to recognize common signs of any collection and ignore their other signs.

- The children can analyze each element of the collection, evaluate its scale based on the number of elements in such collection. Other factors such as the size of the elements, the space in which the collection is located, and influence on perception and evaluation for the size of the collection.

+ Large preschoolers (5-6 years old)

Children are better able to separate each element of the collection, they can imagine that the elements of the collection are not only individual objects but maybe a group of objects. The trend of collection assessment increases in quantity and is no longer affected by dimensions, space, or other external characteristics (Nguyen & Trinh, 1998).

- ***Characteristics of comparing the number of object groups of preschoolers***

+ Little preschoolers

- Demand for comparing the quantity between groups of objects also begins to form in children. At this time, the children almost rely on their visual feelings to compare the number between groups of objects.

- The research results show that ability to recognize plurality in children is also influenced by several other factors (external characteristics, spatial arrangement, and space occupied by elements of the collection) such as:

- When the children begin to recognize the limits of the plural, they intend to choose the “plural” based on the same unity of an external common characteristic (color, type, shape, size)

- The arrangement in the space of elements in the form of a closed pattern (square, triangle) will help children to acquire the plural as a complete set better than the arrangement in rows. However, the arrangement of elements in rows will facilitate quantity acquisition and it is easy to see individual elements of the collection (an important basis for children to learn how to count in the future).

- Because the children are quite slow to separate each element of the collection, they are often used to evaluate the scale of a collection not according to the number of elements making up the collection, but according to the spatial dimensions occupied by the elements.

For example, if five candies are in one place, and three candies are in a wider space, then the child mistakenly thinks that five candies are less than three candies.

+ Average, older preschoolers

Children can compare the number between two groups of objects (little difference in number) by establishing a correspondence 1 - 1 between each object of those two groups. The children have a demand to determine accurately the number of elements in the collection. Therefore, when doing with a specific collection, the children begin to use numbers and counting, so they start to master the role of numeral results. Children can use counting to compare the number between groups of objects (Trinh, 1996).

3.2. Activity of remembering and counting of preschoolers

Children can read by heart the numbers in a sequence of 5, 10, or more. However when counting large numbers of objects (more than 5) they often missed or repeated.

The 4-5-year-old children have a skill of analyzing each element of the collection andknow how to evaluate their scale based on the number of elements. The counting operations of children are formed based on practicing a correspondence 1: 1 between elements of collections when counting.

As regards the influence of teaching, the 4-5 year-old children quickly master the counting and easily distinguish the process and results of the counting and understand the general meaning of numbers - as the index for the number of elements in the collection. The children understand that the collection with equal numbers of elements will be expressed by the same number, while collection with a different number of elements will be done by different numbers. However, children face difficulty to count large numbers of objects, so they should only be taught to count the number in a range of five (Dinh, 2004).

The counting activities of older preschoolers develop to a new step, they love to count and most children know the sequence of numbers from 1 to 10, even more. The children know how to establish correspondence 1: 1 in the counting process, each number corresponds to one element of the collection that they count. They not only understand that the last number they count is the final results corresponding to the entire group of objects, but they also start to understand that the number is the index for the number of elements of all collections with the same scale without depending on their characteristics, properties, and arrangement. Their counting skills become more and more proficient, the children not only count correctly the number of groups of objects but also the sounds and movements, thereby they understand the better role of the number.

On the other hand, children not only count each object but also each group of objects. Moreover, through teaching, older children not only count normally but also count down in a range of 10.

3.3. The symbol of size of preschoolers

- **Senses on size in kindergarten children**

From an early age, children accumulate experiences of sense and determine the size of objects. These experiences are gradually accumulated during the process when the children do with objects and toys of different sizes. At the age of 1, the children's sense of size gradually becomes more stable. The older the child becomes, the more stable the size perception becomes. At the age of 2, although children do not yet understand the positive language, they react to the different sizes of objects and their size relationships. The size sign perceived by the child is often associated with a specific object, familiar to the children and it is an absolute sign for them. *For example*, children always think their car is bigger than their friend's car without comparing the size.

- **Sense on size of preschoolers**

Children aged 3-4 are difficult to understand the relativity of the concept of size. For example, there are three or four similar objects in front of children with ascending size, they often perform the task of pointing the biggest and the smallest. However, if the teacher put away the biggest object and then asked the children to point to the biggest in the rest, the children will answer that "the teacher put away the biggest object". In addition, children often do not know how to choose an object with similar size to each other. *For example*, children try to put their feet in a doll's socks, or wear a big mother's hat, try to put a big doll in a small bed

Sense of size in three-year-old children still not be enough delimitation, children often point to the general size of an object without separation of each dimension of the object, such as its length or width.

By the age of 4, children know how to select objects according to their length, height, width more correctly. Most 4-year-old children do not understand the meaning of size, so when asking them about the size of objects, they often answer about their color, quantity.

Large preschoolers can distinguish three dimensions (length - width - height) of objects, children can also use a ruler to assess the size of objects, understand the relationship between "size" of a ruler and size of an object.

3.4. Symbol of time at preschool ages

The formation of time symbols in children is a long and complex process. Initially, time symbols are formed based on perception associated with cyclicity of life processes taking place in the human body with the support of different sensory complexes: vision, hearing, feelings, etc. Then the time symbols are gradually recreated and increasingly generalized because it has a logical factor – knowledge of time measurement standards (Do, 2003).

The children can find it difficult understanding the meaning of words describing time and time relationships due to their relativity. The words like: now, today, yesterday, tomorrow always change depending on the specific moment in the reality, so it is very difficult for children to understand their meanings and differences. In order to understand time relationships, children's abstract thinking activities must develop at a high level.

The older the children are, the faster the vocabulary on time grows. For children from 1.5 to 2 years old, the adverbs of time appear, followed by chronological order adverbs such as, now, a moment ago, initially, or currently. Time plays an important role in mastering chronological order. Although children are often limited to symbols for short periods, they often confuse some adverbs of time such as: first, now, currently, then, today, tomorrow, yesterday. They often use adverbs such as long, fast, then, at that time, long time ago, in the future, so on easily because their meanings come from the real life of children. For words such as "fast" and "slow," they will be understood as the frequency of activity, not the speed of activity, the word "at that time" attached to the symbol of "today", the word "long time" associated with the event took place a few days ago. Children at the age of 0 to 3 years express the length of time in an indeterminate form like "fast" or "slow".

Along with the growth of children, their ability to determine time is gradually better. The older the child is, the more interested he/she will be in learning about time, which is shown clearly via their words and questions. For example, children are very interested in understanding the clock, they often ask: "when is tomorrow?", "What time is the clockwise pointing this number." Or children often use words such as today, yesterday, tomorrow.

Along with the development of age, time symbols thrive in children. The research results show that children aged 0-3 years have not mastered the past and future time. When they grow at the age of kindergarten (3-6 years old), they can distinguish the past, the present, and the future associated with specific events. The length of time is not only perceived by feelings, but also inference. However, the time symbols in preschoolers are specific and often associated with specific phenomena and events.

Preschoolers are very interested in time relationships, they specify a time in events associated with a certain timeline. For example, "Why didn't you go to school yesterday? Is it Sunday?". The 5-year-old children have established correct connections between repetitive events over time, such as: "Morning - before a meal", "afternoon – when mom comes home from work." Children often identify the time of events through other specific events, for example, "we will be given a gift when we wake up".

Along with the accumulation of time-oriented experience, children's time symbols are also formed based on objective natural symbols such as "It's morning, it's shine, the sun rises", "Night – when it is dark, everyone is sleeping." Children identify time according to events with different signs. Children begin to distinguish the sessions of the day in

association with activities that always take place at that time or based on some familiar events giving them emotional and attractive impressions such as: “Tet - that is spring”, “Going to the beach – it’s summer.”

From the above analysis, it is shown that preschoolers all have symbols of standard time measurement such as hours, days, weeks, months because the symbols of children's length are gradually formed when children participate in activities. different activities. The knowledge about time measurement is very vividly learned by children, but children’s symbols for short periods such as minutes are vague, abstract, and merely verbal. Therefore, in the process of teaching children, it is necessary to make it specific with emotional content. The preschoolers identify accurately the time relatively that is not long and have a certain symbol based on their own experience, they know that after day-off, they will learn Music and Maths so they will wait and prepare to learn it. However, the symbol of time length for lessons is very inaccurate, the symbols of longer periods and old time are even vaguer.

Speech plays an important role in the formation of time symbols. Speech expresses a different kind of time, generalizes, and abstracts the lengths of different periods. The vocabulary for the time at the age of kindergarten develops rapidly. According to the researchers, the vocabulary for time develops strongly in children from 5-6 years old. However, the development of vocabulary about separate kind of time is uneven, children are worst to understand adverbs expressing the order and length of time, they are best at adverbs of speed and identifying events in time. This proves that their symbols of speed are often more intuitive and easier to form than symbols of length. However, children will understand the meaning of adverbs of time more precisely if instructed by adults.

4. Conclusion

The formation of the basic mathematical symbol for preschoolers is one of the important goals of preschool education. Each age has its content to form mathematical symbols for children such as quantity, number, counting, space, time, shape, and size. In order to do that effectively, it must come from a background in psychology, from the relationship between psychology and mathematics, from the formation and development of intelligence based on psychology in a scientific and Dialectic way. Therefore, we think it is necessary to continue to have in-depth and interdisciplinary studies between psychology and mathematics in early childhood education.

❖ ***Conflict of Interest:*** *Authors have no conflict of interest to declare.*

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CƠ SỞ TÂM LÍ HỌC NHẬN THỨC TRONG HÌNH THÀNH BIỂU TƯỢNG TOÁN HỌC CHO TRẺ MẦM NON

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TÓM TẮT

Bài báo đề cập cơ sở tâm lí hình thành biểu tượng toán học cho trẻ mầm non. Kết quả chỉ ra rằng tâm lí nhận thức là cơ sở để hình thành các biểu tượng toán học cho trẻ mầm non, như: số lượng, số lượng, chữ số, không gian, thời gian, hình dạng và kích thước. Tuy nhiên, ở mỗi độ tuổi mầm non, nội dung, hình thức và phương pháp hình thành khác nhau với nhiều yêu cầu khác nhau dựa trên sự phát triển tâm sinh lý của trẻ và phù hợp với đặc điểm phát triển của từng trẻ. Điều đó cũng chứng minh rằng định hướng tác động phù hợp như tích hợp liên môn trong giáo dục mầm non sẽ nâng cao hiệu quả chăm sóc, giáo dục trẻ.

Từ khóa: toán học; trẻ mầm non; tâm lí; biểu tượng; tích hợp