



Mathematics Learning for Students of Basic Age: Montessori Theory Applicative Review

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Abstract

Although previous studies have discussed about the theme of Montessori theory in learning mathematics, but the focus of studying in basic age students needs to be done in depth. Because, basic age children are seen as crucial age in teaching concrete and critical thinking skills using the Montessori method. This study aims to describe how the Montessori method in learning mathematics. The research procedure is carried out based on literature or literature studies. The results of the study found that operationally the application of the Montessori method in mathematics learning: First, the introduction of identity that can be done by making a relationship between the visual aspects of an object and its name. Second, recognition of comparison. This step is carried out to find an affirmation of the level of student understanding of the material. Third, make a variety of visualizations but allied and require students to be able to explain it. With the steps that provide attention to the development of the learning reasoning will gradually reduce the "phobia" of students to mathematics, and will have implications for increasing mathematical learning outcomes.

Keywords: *Thinking skills, Montessori methods, Learning mathematics.*

PRELIMINARY

The Montessori method is one alternative teaching giving for basic age children. This is based on the suitability of the child's thinking stage in the concrete thinking phase (Putri & Alfarisa, 2022; Rahayu, *et.al.*, 2020). Then, the Montessori teaching method always uses manipulation materials to convey the basic concepts of mathematics (Nugrahanta, *et.al.*, 2016; Mumtazah, 2018). Furthermore, in Montessori theory, saying that when educating children, we want that they are unique individuals and will develop with their own abilities (Susiaty, *et.al.*, 2021; Sitinjak, *et.al.*, 2021). Our task as adults and teachers is to provide a means of learning encouragement and facilitate when they are ready to learn something.

Judging from its essence at the level of basic education mathematics is abstract which is far from the reach of the ability of elementary school age children especially for children who sit in low class, but mathematics needs to be learned from elementary school in low class whose intellectual thinking stage is still related to concrete objects so the thinking process is still very limited (Zahidi, 2020; Hidayat, *et.al.*, 2020). Thus, mathematics that will be taught to elementary school children must be in accordance with the child's ability to conquer the concept of abstract mathematical.

In the field of mathematics study the rules of one concept with another concept are interconnected. Where, mathematical thinking is related to super structures that are appropriately formed from what had been previously formed (Yusshinta, 2023; Shantiyana, *et.al.*, 2017). Mathematics is one of the sciences taught in schools both at the level of primary and secondary education that cannot be separated from the development of science and technology, therefore the increase in teaching mathematics at every level of education needs to be improved (Sintawati & Mardati, 2021).

Education is one of the important aspects in life to shape quality human resources and be able to follow the flow of increasingly advanced times (Sakdiyah & Ihtiar, 2021). In addition, education is one of the important and dominant sectors in determining the progress of a nation. Therefore the education sector needs to get special attention, especially in terms of expansion or equitable learning opportunities

for each citizen in addition to the utilization of all system units to achieve the quality of the expected educational outcomes. The realization of these quality communities is the responsibility of education, especially in preparing students to become subjects. Increasingly play a role in displaying the superiority of his resilient, independent and professional in their respective fields.

In fact, many relevant studies have discussed the theme of the Montessori teaching theory in mathematics learning. Including discussing from the aspect of developing mathematics learning teaching aids (Wahyudi, 2019), Mathematics Learning in Pandemi Covid-19 (Sulha, 2020), efforts to build the logic of children's thinking (Haloho, 2022), Practicing thinking skills to students with disabilities (Cipta, *et.al.*, 2019), understanding of mathematical concepts in children (Aziza, *et.al.*, 2020), and operational material counting on mathematics learning (Fadillah, *et.al.*, 2022).

Observing the above, it is understood that the previous study has a gap that has not been examined, so that it can be used as an aspect of novelty and distinguishing analysis in this research. Thus, urgent research is carried out discussing the theme of Montessori teaching methods in learning mathematics for children of basic age. Through this research, it is expected to be the right concept in teaching mathematics in elementary schools, especially the application of relevant Montessori theory in helping children's growth and development.

METHOD

This research uses a qualitative approach with a literature study method. The Focus of the Problem Studies is learning mathematics using the Montessori method for elementary school students. Research Data Sources Were Obtained from Credible Pages Including Google Scholar and Sinta. The data in question includes scientific articles, books, proceedings and final assignments (thesis or dissertation). Next, the data was analyzed and the validity of the data was checked using research data triangulation techniques (Assingkily, 2021).

FINDINGS AND DISCUSSION

Overview of Mathematics Learning

Mathematical Nature

The essence of mathematics is related to its ideas, structures, and relationships that are arranged in a logical sequence. There are also those who suggest that mathematics is a study of the patterns and relationships of a way or pattern of thinking, an art, a language, and a tool (Darnis, 2018). As said at the beginning, that the definition of mathematics focuses on the review and point of view of the definition maker, so that there is no agreement about what it means mathematics in terms of terminology, but can be seen from the characteristics of mathematical understanding in general, namely: Having an object of abstract study, based on agreement, patterned deductive thinking, has an empty symbol of meaning, paying attention to the universe, and consistently in the system (Suprahawati & Komalasari, 2014).

This shows that school mathematics is not entirely the same as mathematics as a science. The difference lies in: First, how to present it, the presentation in the Mathematics book at school is not always starting with theorem or definition (Yuliandari & Mahyuddin, 2020). Adapted to the intellectual development of students. Second, the mindset, in school mathematics, although still expected to be able to think deductively, but in the learning process can use an inductive mindset. Third, limited limitations, in mathematics in elementary schools are seen gradually introduced positive integers, then even more upwardly introduced fractions and negative numbers. So it should be narrow and then extends. Fourth, the level of abstractness, at the beginning of the low abstraction level education, the higher the education the higher the abstraction level (Widodo & Amanah, 2022).

Related to the functions and objectives of mathematics taught in elementary schools, mathematics functions to develop the ability to count, measuring, reduce and use the mathematical formula needed in daily life through measurement material and geometry, and algebra. In addition, school mathematics functions to develop the ability to communicate ideas with language through mathematical models that can be in the form of sentences and mathematical equations, graphic diagrams or tables.

Learning and Teaching Process

As the previous discussion mathematics regarding structured ideas that are very hierarchical, so to study a particular concept must master previous concepts. For example, to study the concept of "B" must understand and master the previous concept, the concept of "A", it is impossible for a student to be able to understand the concept of "B" before being able to understand the concept of "A". So if for example to understand the concept of multiplication, must first understand the concept of addition. For example, to understand about fractions must be understood in advance about natural numbers, because fractions are based on natural numbers.

On the basis of the cognitive structure of students, the learning material must be arranged according to the sequence of logical levels of difficulty and based on previous learning experiences. According to Ausubel, the learning material learned must be "meaningful" (meaningful) means that the learning material is suitable for the ability of students and must be relevant to the cognitive structure of students. In other words, new lessons must be associated with existing concepts so that new concepts are completely absorbed (Lestari, 2022).

In short, the teaching of mathematics to students is as follows: In the process of learning mathematics we must pay attention to the stage of students to understand the concepts, namely the stages: free play, games, study of shared nature, representation, symbolization, and formal (Faizah & Wiarsih, 2024). In instilling the concept of mathematics we are to use props and / or models, the presentation so that it is diverse and in accordance with the concepts to be instilled. In accordance with the essence of mathematics as a creative science and the nature of children who like to play, present the teaching of mathematics in such a way as to support the conditions and expectations (Indyati, *et.al.*, 2020).

As stated, learning with regard to the process of behavior change and in teaching teachers as facilitators, in the process of teaching and learning the teacher is a mediator, environmental mixer how students are able to receive, manage and process information systematically in mathematics in accordance mathematics.

Understanding and essence of the montessori method

Understanding the Montessori Method

Montessori method is an educational method for children who in their preparation are based on the theory of child development (Nurbaiti, *et.al.*, 2020). The characteristic of this method is to emphasize the activities that are raised by the child and emphasize the adaptation of the child's learning environment at the level of development and the role of physical activity in absorbing learning concepts and practical abilities. Something more important for the idea of Montessori which states that education must continue in accordance with development. Most of the decisions taken by educators through the curriculum and their supporting activities are encouraged by curriculum goals or the necessity of students working on exam questions (material) based on certain chronological ages without losing the stages of individual individual development (Ramadianti, *et.al.*, 2024).

The emergence of this Montessori method of thought originated from children with special needs (mental retardation), where children with special needs have a very minimal visual/ audiovisual learning ability and have such limited memory/ retention skills. This causes limited cognitive development (Ridwan, 2021). With such a condition, a approach that uses all the senses and motorcycles of children (kinesthetic/tactic) was created in learning through hand on) to help growth and development. The Montessori approach has a strong enough footing because it is a derivative of classic theories that are tested for its validity. Montessori's philosophy itself is not new in the world of educational psychology, or in the world of special education. Field research on this method continues to develop and show improvements.

Montessori Method Essence

Based on the observations of the stages of development carried out by Mary Montessori, the Montessori method can be seen as follows: First, The Absorbent Mind. Basically the learning of a child is different from adults. Maria Montessori calls it the absorbent mind/mind that easily absorbs. This ability occurs during birth to the age of 6 years. He observed that since the baby's infancy absorbed the experience of the surrounding environment through all his senses and then processed through the brain. Through this absorption process, the mind is truly formed. Therefore, children directly assimilate the

physical and social environment where they mingle and simultaneously develop their innate mental power. From birth to the age of 6 years and consists of two different phases: from birth to about the age of 3 years, the child is in the absorbent of the subconscious mind, and during that time the child explores the environment through the senses and movements and absorbs the language of the surrounding cultural (Prasetya, 2015). At this time the child absorbs experience but is not aware of. For example, when children learn languages. His parents never taught him. Language is obtained by children without conscious effort. Language is absorbed by a baby from the rhythm, sound and vocabulary of his mother naturally and unconsciously.

Second, The Conscious Mind. In the second stage of age 3 to 6 years, the child's ability to absorb no longer (absorbent mind) but rather becomes a conscious mind. That in infancy until the age of 3 years when the brain absorbs it naturally and consciously, but after the age of 3 to 6 years the child's ability to absorb become conscious and have a purpose. Children become more active in exploring their environment consciously. The learning process during this period is active. This has implications for giving freedom to children. By giving freedom to children, children can develop all the potential they have. Children are given the freedom to choose what they like. The teacher must not impose certain material on children. The teacher only functions as a facilitator. This freedom is aimed at being sensitive to an ability that encourages to practice one function, the child will be able to practice at will (Sugiarto, *et.al.*, 2018).

Education should not be charged to children. The learning environment must be created in a conducive atmosphere that provides opportunities for children to act freely and develop themselves in their own inner eye lines. Montessori feels that freedom in this modified environment is very important for its physical, mental and spiritual development. Third, the sensitive periods. The Montessori method focuses on sensitive periods that enter the absorbent brain. Based on their observations of children, Montessori informs that through their stages when they keep repeating their activities again and again. They absorb everything he did consciously, something that only attracted him (Putri & Dewi, 2020).

Fourth, Children Want to Learn (children want to learn). According to Montessori, children have the potential or strength in themselves to develop themselves. Children have a natural desire to learn and work, along with a strong desire to get pleasure. Children prefer to do various activities rather than just being entertained or pampered. Children never think that learning as something unpleasant. Children will always look for something new to do that is something that has a more difficult and challenging level. Fifth, Learning Through Play (Kiuk & Susanto, 2023). Playing is a joy, freedom, has a purpose and spontaneously choosing activities, creative, including problem solving, learning new social skills, new language and new physical skills (Khoirunisa, 2018). Playing is very important in young children to help them learn new ideas and put them in practice, to adjust to the social environment and overcome emotional problems. There are many games that can be played with Montessori teaching material through ways to strengthen children learning. The game can be played using equipment made at home. Some can be bought commercially.

Mathematics learning based on the Montessori method

The basis of the early learning process of mathematics should be built when children are three years old. Because at that age, children's interest in numbers is very large. For the next two years the child strengthens his memory of numbers. Then working on simple math problems is not recommended to use a calculator, computers in the early stages of mathematical development (Aulia, *et.al.*, 2023). The reason is this media can teach functions automatically so that children depend on it. Better children have their own knowledge and ability as a reference for further development and do not ask for technological help to solve all questions, although intellectually children do not understand the concepts of numbers, but the children are heading to an understanding of the quantity of quantities.

The decimal system is the basis of the number system. Therefore, a knowledge of the numbers studied from one to ten, the written numbers and quantity symbolized by these numbers are very necessary if children want to fully understand every mathematical problem that they will meet in the future. By using manipulative materials to learn basic mathematical concepts at an early age, children will not find difficulties in understanding the facts and basic skills. Children are expected to be able to move the objects they are counting to get the actual quantity (Cipta, *et.al.*, 2020).

Satisfaction in discovery leads to the enthusiasm of interest in children if children are able to demonstrate the basic operation of mathematics. Physically the child holds the quantity they see represented in written symbols. The children combine the material, count, separation, and temporarily comparing visually touching and strengthening ideas to some extent that this is real, not abstract. The teachers offer to children a concept that already exists and allows children to achieve their realization through the learning process in accordance with the speed of each child (Susilawati & Jannah, 2019). In this way the child sees and understands the relationship between numbers, is also able to absorb the idea that the value of a number is marked by the position where the value is written. First of all, what needs to be taught is the names of quantity, then the symbol of quantity and finally the two are combined.

By using a variety of different materials available for various mathematical processes, children are repeatedly given the diversity of problems in one main theme, understanding the work functions of numbers from one to ten. By holding the material and using it in different ways, concepts that at first glance seem unclear are clear because children not only see basic ideas but find other new ideas (Tusya'diah, 2023). Through repetition, the facts are understood not just to remember. And once the necessary operations are formed, useful knowledge is embedded in children who are taken from the meaning of each operation.

Montessori's education model helps understand the concept of the number, children learn to count in a pleasant atmosphere. Then the numerical concept is introduced through concrete teaching aids, before the child is told to do abstract numerical symbols. After knowing the idea of numbers, children can count numbers up to 1000 without the help of adults. The purpose of this application is to follow the stages of natural development and provide a concrete basic understanding before continuing to further abstract operations. The purpose of the three-stage learning process is to teach new concepts by repetition, thus it will help children to better understand the materials presented to them. This method also helps teachers see how well children master and absorb what is being taught to them.

These three stages should be used in conjunction with each demonstration at the beginning of mathematics. The stages are: The first stage: Introduction to identity: Make a relationship between the object being indicated by the name of the object. Second Stage: Introduction to Comparison. To ensure that children understand, for example by saying, "Give me". Third Stage: The distinction between similar objects. Note whether the children really remember the name of the object, show a variety of objects, and say, "What object is this?" (Wulandari, *et.al.*, 2020).

Introduction to mathematics is carried out through adjustments, sorting and preparation of what children face everyday. Mathematics is introduced to children through clear and interesting concepts. Methods designed and adapted to the needs of children to engineer real/clear materials before they reach the stage of abstract concepts relating to the world of numbers. After children understand the basic concepts of quantity/number and relationship with symbols, another thing is studying greater numbers and mathematical operations such as addition, subtraction, multiplication and division will become more natural. In addition, children can learn mathematics through measurement, such as measuring distance, measuring liters, and measuring the size (Kurniastuti, *et.al.*, 2022). Usually three or even four objects are used simultaneously. If children don't seem to understand one of these stages, start from the beginning again, always ensure that each stage is completely understood before the children continue to the next material.

One example of the stages of learning in the field of mathematics taught in the Montessori education model is as follows, children learn the concept of concrete addition. With the concept of recognition of numbers, children experience how one, two or ten can be seen and felt. Children learn the names of numbers one to ten. The number of sand paper allows the child to see and feel the symbol shape numbers 1 to 10 while the teacher says the name of the numbers held by the child. The child perfects the ability to recognize numerical symbols and the amount by repeating steps 1 and 2 with other props (Hartati, *et.al.*, 2021). For example, children draw the shape of the numbers in the sand or use short bead ladder to arrange concrete amounts. Repeat steps 1 and 2.

Furthermore, the child connects each symbol of numbers with the related amount. With the coil box, the child states several coil bonds and put each bond in a separate box which is labeled the symbol of related numbers. The child repeats steps 1 to 4. This time focuses the decimal system. Using gold beads. Children learn to count 1 to 1000 based on understanding numbers 1 to 10. Children use sequin boards to

associate large numbers. Children start writing numbers (Novita & Muqowim, 2019). If you have not been able to hold a pencil, the child continues to perfect his understanding of the decimal by moving pieces of paper symbols to the appropriate image. Only after understanding the concept of numbers, children begin to learn addition, subtraction, multiplication, and division. Children switch to learning from concrete to symbols. Boards and Mathematics tables make it easier for children to do mathematical operations in the brain. Children learn other mathematical concepts such as fractions, algebra, geometry and size units.

CONCLUSION

Based on the description above, it is concluded that the Montessori method emphasizes the activities that are raised by children and emphasize the adaptation of the child's learning environment at the level of development and the role of physical activity in absorbing learning concepts and practical abilities. The essence of the Montessori method includes: 1) The Absorbent Mind, 2) The Conscious Mind, 3) The Sensitive Periods, 4) Childer Want to Learn, and 5) Learning through play. Learning using the Montessori education model can be used as an alternative variation in the learning process, especially in an effort to improve learning outcomes. So that it can be one of the solutions of the many problems of the quality of education in Indonesia, especially in mathematics education.

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