

Numeracy Literacy in Early Childhood: An Investigation in Arithmetic, Geometry and Patterns in Early Stage

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ABSTRACT

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Early childhood education is a coaching effort carried out for children from birth to the age of six by providing educational stimuli in helping their physical and spiritual growth and development with the aim that children have maximum readiness to enter higher education levels. Numerical literacy in early childhood can be used as a tool used in developing thinking skills in children, supporting children in developing various talents or intellectual potentials they have and can be used as a means of cultivating a positive affective side in instilling basic personality. This study aims to describe a numeracy literacy skills in early childhood students. The research method used is descriptive qualitative. Researchers used purposive sampling to take research subjects, and obtained as many as 28 PAUD students, and from 28 people 3 people were taken to be analyzed in depth related to their numeracy literacy skills. Instruments in this research are observation, test, Interview, and dokumentation. Data analysis techniques in this study include data reduction, data presentation, and conclusions. The results of research that have been done show that numeracy literacy in early childhood aged 5-6 years of arithmetic, geometry and patterns as follows: (1) Be able to name the symbols of numbers 1-20, (2) Have the ability to using number symbols to calculate, (3) Able to match numbers with number symbols and recognize differences based on "more than"; "less than"; and "most", (4) Able to classify objects based on color, shape and size (3 variations), (5) Have the ability to sort objects by size from smallest to largest or vice versa, (6) Can estimate the next pattern after seeing the shape of more than 3 consecutive patterns (7) Meets errors in writing number symbols due to the accumulation of information received by the brain. This happens because at the same time, the brain receives information in the form of numeric symbols in Arabic and number symbols in general at the same time, (8) Numeracy literacy activities in the pandemic period for early childhood can still be done one of them with learning involving the environment which without eliminating the element of play but still able to facilitate the development of children.



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A. INTRODUCTION

Early childhood education is a coaching effort carried out on children from birth to the age of six by providing educational stimuli in helping their physical and spiritual growth and development with the aim that children have maximum readiness to enter higher education

levels (Sujiono, 2013) and is the most basic education in developing several aspects of children's cognitive, linguistic, religious and moral development, social emotional and motoric. In early childhood, cognitive development is related to how their thinking abilities develop (Beaty & Silvia, 2013). This cognitive development is related to numeracy abilities in children at an early age which is the basis for their mathematical competence in the future (Ivanova et al., 2020; Kleemans *et al.*, 2012; LeFevre *et al.*, 2013) and will give birth to an important prediction in his academic and language success in the future (Clements, 2020; Clements & Sarama, 2016).

Numeracy ability in children are also associated with math achievement at different ages (Halberda et al., 2008). In early childhood, they actually have shown numerical abilities long before language acquisition and formal education are obtained. However, according to research Ratnasari (2020) mentioned that early childhood could not mention numbers 1-10 in sequence and also could not match numbers with symbols. As for the research Busril *et al.* (2020) explained that parents are more concerned with early childhood to better understand mathematics learning by providing private tutoring, even though according to the data of national literacy movement (Kemendikbud, 2017) in research Ratnasari (2020) said that knowledge of mathematics alone does not affect a person's ability to have numeracy literacy. Numerical literacy skills in early childhood are categorized into several interrelated domains, namely numbering, relationships, and arithmetic operation (Cross, 2009). Numbered skills include knowledge of arithmetic sequence rules and the ability to flexibly obtain quantities (Purpura & Lonigan, 2013). The results of previous research conducted by Hikmah *et al* (2016) stated the results of research that through number card games, numeracy skills in early childhood can develop. In addition, the results of research conducted by Nurjanah (2017) describe the results that the application of Inquiry Based Learning in early childhood can improve numeracy skills and number operations. Furthermore, the results of research conducted by Setiawan (2018) show the results of research that through learning media mathematics addition ability in early childhood can increase. Yulianti *et al* (2019), the results of their research show that the introduction of role playing has an effect on the introduction of numeracy literacy in children. In a subsequent study, Busril *et al* (2020) in their research results stated that the Logico game had an effect on increasing children's numeracy skills. The results of previous studies have also shown a relationship between early childhood understanding of mathematical language and numeracy skills (Purpura & Logan, 2015; Purpura & Reid, 2016; Toll & Van Luit, 2014).

So far, from the results of research conducted by previous researchers, no one has explained in detail how numeracy literacy is in early childhood. Moreover, for the past 2 years our country has been hit by a prolonged pandemic. This research is different and expands on previous work, namely by analyzing early childhood numeracy literacy in terms of arithmetic, geometry, and also patterns. Therefore, the researcher considers that research on numeracy literacy in early childhood is important in order to further prepare the best strategies and methods to maximize numeracy literacy from an early age.

From observations made to several early childhood schools in the city of Karawang, the results obtained are that there are several problems faced by early childhood school today. The first is the issue of curriculum, quality of early childhood school programs and

institutions. The second is school lands are very minimal so that the activities of playing while learning which are the main activities of early childhood students are very limited. Third, there are still about 1/3 of children aged 3-6 years who have not received early childhood services. Fourth, family involvement is not in line with early childhood institutions. Fifth, the level of teacher education, where less than 50% have bachelor's degree and the rest are still at the diploma level, so that the ability of teachers to carry out the learning process in the classroom must continue to be improved. The sixth issue is education investment. The seventh problem is nutrition. The next problem is early childhood learning, which should 80% build attitudes and character, currently focuses on reading-writing-counting learning with an academic nuance. And the last problem is learning system for early childhood learning in pandemic period very hard to implemented.

From the problems expressed, the researcher highlights the 8th problem where at this time the focus of learning in early childhood is more focused on reading writing-counting or literacy numeracy activities. Counting activities in early childhood are related to their numeracy skills. Children's knowledge of the language of mathematics implies their early numeracy skills and abilities (Purpura & Logan, 2015; Toll & Van Luit, 2014). Early mathematical skills in children at an early age are the basis for their future mathematical competence (Esplin et al., 2021; Nesbitt et al., 2019; Simanowski & Krajewski, 2019; Kleemans et al., 2012; LeFevre et al., 2013). In early childhood, in fact they have shown numeracy skills long before the mastery of language and formal education is obtained (Purpura *et al.*, 2017; Schmitt *et al.*, 2017; Wolf & McCoy, 2019). Thus, numeracy literacy in early childhood can Becoming a tool that can be used to develop thinking skills, support children in developing various talents or intellectual potentials they have can also be a means of cultivating a positive affective side in instilling the basic personality as early as possible, such as a critical attitude, never give up, independent, scientific, rational and others (Nur *et al.*, 2019). Therefore, researchers have an interest in conducting an investigation related to arithmetic, geometry and patterns, in early childhood education students. From the results of this study, it is hoped that research results can provide improvements in the quality of learning in developing numeracy literacy skills especially about arithmetic, geometry, and pattern in early childhood because a number of researchers (Presser et al., 2013; Rudd et al., 2008; Vitova et al., 2015) recommend so that we pay more attention to the training of early childhood teachers in this area, so that they will further develop math skills in preschool children using appropriate activities

B. METHODS

This study uses qualitative descriptive methods in this study. The subjects in this study were taken purposive sampling with reference to the criteria that have been determined. The study subjects were 28 early childhood students between the ages of 5-6. In this study, researchers also acted as key instruments, namely researchers as data collectors through observations, tests, interviews, and documentation. This research was conducted in four stages, namely: the preliminary stage was carried out with field observations. In the second stage, the researcher went into the field, where the researcher collected data by giving a numeracy skill test directly to the child and completing the test result by conducting

interviews and questions and answers with the teacher. the third stage by analyzing the data. Data analysis was carried out by researchers by reducing data, presenting data. and the fourth stage is drawing conclusions. As shown in Table 1.

Tabel 1. Indicators of Arithmetics, Geometry, and Pattern for Early Childhood Students

Study	Indicator
1. Aritmetics	<ol style="list-style-type: none"> 1. Students can number (recognize the concept of numbers with objects) up to 20. 2. Students can match numbers with number symbols.
2. Geometry	<ol style="list-style-type: none"> 1. Students can pair objects according to their partners, types, similarities, colors, shapes.
3. Pattern	<ol style="list-style-type: none"> 1. Students can estimate the next pattern after seeing the shape of more than 3 consecutive patterns

In the first stage, namely the preliminary stage researchers make direct observations into the field to conduct preliminary studies on school conditions, children's abilities, and learning activities in school. Observations were made based on an agreement with a teacher who teaches at one of the early childhood schools in the Karawang district. In this case, observation depends on when the teacher carries out numeracy development activities in schools. Researchers conducted unstructured observations where researchers did not use guidelines to observe what behavior the teacher and students were doing using field notes. At each meeting, the researcher recorded all development activities both inside and outside the classroom. If there are activities that become questions for the researcher, then interviews with the teacher are conducted to confirm the actions that have been taken. All activities were recorded using 3 video cameras placed in front, side and back of the class.

In the second stage, it is the data collection stage. At this stage, researchers jump into the field directly to provide numeracy literacy tests in early childhood. Researchers also recorded the activities children did at school using handycams. In this study, the test is in the form of a essay question that is equipped with pictures. Because students still cannot read, then in filling it the researcher reads the questions to be filled in by the students. The documentation study in this research was carried out by analyzing the daily study plan that had been prepared by the teacher, circulars, notification letters, photos of learning activities and various kinds of assignments and other written documents given by the teacher.

The third step is the data analysis stage where the researcher does it by means of data reduction, then presents the data and finally draws conclusions. In addition, to strengthen the results of research and data analysis processes, researchers also conducted interviews with teachers who teach early childhood. After the collection of data and research in the field is enough for researchers, then the researcher continues the research to the fourth stage, which is the stage of preparing reports.

C. RESULT AND DISCUSSION

1. RESULT

a. Observation

In the observation activities carried out by researchers regarding numeracy literacy in early childhood during the pandemic with this limited face-to-face learning system, the researchers found that early childhood education schools in the Karawang district already have assessment indicators that have been prepared according to the curriculum used. The impact of distance learning that has been carried out previously leaves many obstacles that are feared to affect cognitive development in children. For example, when distance learning is implemented, learning is carried out online. For children aged 5-6 years, they have not been able to sit quietly for several hours in front of a laptop or cellphone to participate in learning activities, because at their age an explanation of something must be done by showing real objects and repeated explanations. Moreover, when online learning is experiencing connection problems, it will clearly affect the knowledge transfer process in early childhood.

When distance learning is implemented, numeracy literacy activities are carried out online or at home visits with a very limited time, forcing the school to really have to be able to make maximum use of time amidst the demands of the existing curriculum. Related to children's abilities and activities at school during distance learning, this raises several points that are in the spotlight, namely where teachers are unable to carry out learning optimally and cannot provide appropriate assessments. For example, when numeracy literacy activities are carried out, children are given questions or questions about mathematics in everyday life, teachers cannot know and assess how children can solve given problems, because teachers cannot witness firsthand how children solve the problems given. In addition, during this pandemic, more children are at home, and they are doing learning activities at home where the way to explore children's knowledge at school and at home is different so that it will give different results (ability).

b. Test

To analyze in more detail, researchers tried to describe the results of early childhood answers in 3 children in each question / question asked by researchers on the study subjects. In the first question given to the participants, different results were obtained.

1) Arithmetic

Questions numbers 1, 5, 6, and 7 are arithmetics questions. For problem number 1 presented a picture of various shapes along with its color. Participants were asked about what shape the image presented in the image, what color it was, and how many images it was. Participant 1 can easily and quickly answer the name of the object being asked and can smoothly mention the color. When asked how many and told to write the numbers, participant 1 was able to answer and calculate and write the number quickly and correctly. For participant 2, when asked about the image and color can answer appropriately. But when told to write the number symbol from the

number of images presented, participant 2 wrote the number 3 symbol in reverse. When analyzed further, it turned out that there were several number symbols and letters that were inverted written by participants 2. While participant 3 like the 1st participant, was able to answer and write number symbols quickly and correctly. Question number 5 is a matter of number symbols. Presented empty places that must be equipped by the participants to write numbers from 1 - 20. Participant 1 and participant 3 can smoothly and quickly complete the empty number symbols with the right number symbols. While participant 2, made some mistakes related to the authorship of number symbols. For example, when answering the number 12 symbol, participants wrote the symbol with the symbol S1. Another example when writing a number symbol that is supposed to be the symbol 18, is written with the symbol 81. Problem number 6 is pairing between the number of images with the symbol of the number. All three participants were able to correctly answer the question. In the number 7 question which is the last question, presented the problem in the form of a random arrangement about the smallest to the largest object. The three participants were able to correctly arrange which objects were the smallest to the largest and vice versa.

2) Geometry

The next test is test number 2, is a matter of geometry that contains square, circle and triangle images. The three participants when asked about the name of the geometric shape presented answered the same thing. All three refer to squares by the term or designation "box" and say circles by the term "round". As for the shape of the triangle, only participant 1 answered correctly that the shape of the image was named triangle while participants 2 and participant 3 said that they did not know what the name of the wake. When told to calculate the same number of shapes of the geometric shapes, participants 1 and participant 2 answered correctly about the number of objects of the same shape, while participant 3 made a slight mistake because it was less careful in calculating the number of images.

In question number 3, presented an image that is in the form of a boat in its entirety arranged from several geometric shapes, namely circles, squares, rectangles and triangles. When asked what the image was in, the three participants correctly replied that the image was a boat or boat. Then the researchers instructed to calculate how many geometric shapes each shape was for. Participant 1 was able to group and calculate correctly each of these geometric shapes even though in the image there is a triangle whose position is reversed. Participants 2 and participant 3 can group and answer correctly some geometric shapes, while for geometric shapes both are not perfectly grouped and answered correctly.

3) Pattern

Problem number 4 is a matter of pattern. The participants were told to continue the pattern that had been written before. From the results of the study obtained that only 1 participant was able to capture the instructions correctly and continue the

pattern according to the image exemplified. While participant 2 and participant 3 when answering the question about this pattern did not continue the pattern presented, but repeated the pattern from the beginning, which was presented on the problem.

c. Interview

Interviews were conducted with early childhood education teachers. The purpose of this interview is as a source of information or cross-check the data when in the results of this study the researcher finds something that must be discussed.

2. DISCUSSION

From the findings that have been presented, it can be shown that numeracy literacy in early childhood is one of them related to how children are able to recognize, understand, and write correctly number symbols, and can understand what the meaning of stories and questions told by others. This numeracy literacy ability begins with the ability to recognize the amount of an object. The number symbols one through ten are the basic symbols in counting. Some schools emphasize prospective students to be able to sort numbers up to twenty and reorder them in reverse. Even demanded already able to sum and subtract ten. From the results of this study obtained the finding that the three participants were able to understand what was ordered, calculate correctly the number of objects and were able to write the symbols of numbers according to the number of objects. Although there are still 2 participants who reverse the order or shape when writing the symbol of the number, but in essence the child already has the basic ability to count well. When traced further why the writing error occurred in participant 2, it turned out that participant 2 did not experience dyslexia but there was an accumulation of information in his memory as a result of learning simultaneously between number symbols in mathematics in general by learning number symbols in Arabic in his religious school. As a result of the accumulation of information, for participants 2 writing number symbols in mathematics is generally mixed with the system of writing numbers in Arabic so that it is still reversed when writing. However, we do not need to worry excessively about the occurrence of writing errors in the 2 participants. Researchers still assume that the 2 participants are still in the process of growing up with the development of each individual that is different from other individuals. Participant 2 only needs more assistance and guidance with the provision of additional interventions. Intervention here can be in the form of presenting tutors or done by parents themselves.

The thing that distinguishes early numeracy skills from numeracy literacy in this study is the extent of children's understanding of the language of mathematics. The language of mathematics is a child's knowledge and understanding of key words in mathematics, such as quantitative words such as "more than" and "less than" (Barner *et al.*, 2009) as well as spatial words such as "before" and "after" (Pruden *et al.*, 2011). An understanding of a particular term in mathematics is thought to facilitate the extent of understanding more complex numerical concepts (Barner *et al.*, 2009). The most important thing is that the understanding of specific words such as "most" and "least" is separate from conceptual knowledge of the right amount and numeracy skills. Therefore, numeracy literacy is a separate form of

construction that considers the knowledge of keywords/concepts used in early mathematics, while early numeracy skills indicate a child's ability to work with exact numbers (e.g., counting, comparing, summing).

In Piaget's theory of cognitive development, children ages 2-7 are at a pre-operational stage where they still use intuitive and non-logical reasoning skills that tend to look at things else from their own point of view and expect others to do the same with themselves (Hebe, 2017). Under these conditions, the language of mathematics would be associated with complex numeracy skills above and beyond common languages because the language of mathematics is significantly related to cardinality, connecting numbers by numbers, set comparisons, number comparisons, number sequences, and story problems (Hornburg et al., 2018). Children's early numeracy skills are categorized into several interconnected domains: numbering, relationships, and arithmetic operations (Stipek, 2013). In counting verbally or verbally, when for example children are asked to count one, two, three, and so on with a loud voice, can be obtained through memorization that they have and do not need an understanding of the deeper structure (e.g. knowing that the three are more than 2, etc.). The ordinal link between number words in the count list is not made explicit when they are spoken only sequentially (Spelke, 2017). Therefore, counting orally or verbally is predicted to relate only to language skills in general rather than mathematical language in particular. One-to-one correspondence is defined by each number word spoken when pointing to a different item (Dowker, 2008) is another basic principle that we can teach children without understanding quantitative words such as "more than" or spatial words like "last." In fact, some children are able or successful in counting to generate every number in their count list but fail to gain conceptual understanding and are unable to properly assess the words that appear later in the count list when referring to larger magnitudes (Davidson *et al.*, 2012). Numeracy literacy is also alleged to have a significant positive relationship with children's activities in matching numbers with the number of objects (e.g., a collection of objects). Children's understanding of cardinality relates to the development of numerosity-based representations (Rousselle *et al.*, 2004) and their ability to represent written numbers (Zhou & Wang, 2004). Researchers suspect that the skill of linking numbers to their quantity is related to children's understanding of cardinality.

Based on the results of this study and associated with the principles of logic, according to Smith (2002) the development of mathematical thinking skills is related to the development of children's ability to understand and compose related statements in which the ability is in the form of the ability to compare, classify, and understand correspondence one-on-one, and it is included in numeracy literacy. For example, when studying the meaning of a number that is the same number, less or more than other numbers. Numeracy is related to the ability related to numbers. This is in accordance with the theory according to Walle (1994) which states that numeracy is an understanding of the perspective of numbers (sense of number) that is understanding the meaning of numbers, compound relationships between numbers, recognizing the value of numbers, knowing the effect of number operations that include adding, less, times, for the value of numbers and stating the size of something in the real world.

During the COVID-19 pandemic, face-to-face activities carried out in schools must be temporarily diverted at home with direction and assistance and primary guidance under their parents. This confirms that in this pandemic period numeracy literacy activities remain an important thing that must be given to children but the main responsibility shifts to parents at home. This becomes crucial because the use of mathematical language by parents and teachers is a prediction of the growth of children's numeracy skills (Daubert et al., 2018; Gunderson & Levine, 2011; Klibanoff et al., 2006; Levine et al., 2010). Therefore, we predict that understanding mathematical language will be related to performance on story problems in children and outside of common languages. The results of in-depth interviews to several teachers in early childhood education schools in karawang regency that in the pandemic period, learning activities conducted on home visit and online in early childhood still pay attention to aspects of numeracy literacy activities. According to one of the teacher's confessions, at the time of home visit activities such as the day carries the theme of plants. Then the teacher invites children around the study site to look for plants. The teacher instructed the children by telling them to collect the leaves around the location of the home visit activity. Then the leaves are counted by each child. Once calculated, the number of the count is written in the book. Then the number is written repeatedly as many as a few lines. From these activities, according to him, children can still play, while learning mathematics as well, while training their motor also by writing, listening and understanding instructions from teachers, as well as training the social emotional side as well. In addition to learning to recognize numbers, numeracy literacy activities for geometry materials are usually teachers using origami paper. For example, the teacher makes a triangle from the origami paper. Then the teacher showed it to the children. The children were asked simultaneously what form the teacher was making. Then the teacher told him that the shape was a triangle. After that the teacher asked again if at the location they studied there was a third facet? While guiding, teachers and children look for triangular shapes around them. According to the teacher, this activity is one of the numeracy literacy activities in the pandemic period. Here are some numeracy literacy activities that early childhood children do in the pandemic period. As Shown in Figure 1.



Figure 1. Numeracy literacy activities in times of pandemic

From the image presented in Figure 1, it is an arithmetic introduction activity where children are asked to attach rice grains to be attached to the image of the rice tree. it aims, in addition to introducing children to the shape of the rice plant, also to train motor skills and hone the character of perseverance in early childhood. In addition, in the activity of sticking

seeds, children will feel that they are doing fun playing activities because they are counting how many seeds should be attached to each branch of rice so that there are 2 positive activities that they do not realize, namely learning to count. and hone their motor skills. From the findings obtained, it can be concluded that numeracy literacy activities, especially those related to arithmetic, geometry and patterns during the pandemic period for early childhood can still be carried out, one of which is learning that involves the environment without eliminating the element of play but can still facilitate children's development. In addition, in Figure 1 it can also be seen that students are being introduced to numeracy, namely by recognizing number symbols from 0 to 10. The children are directed to fill in objects (bottle caps that have the same size) and match them with the number symbol. This is in accordance with the results of research which states that outdoor activities improve cognitive, social emotional and motor skills in early childhood (Yıldırım & Akamca, 2017). So that during the current pandemic, children's numeracy skills in arithmetic, geometry and patterns have developed well.

D. CONCLUSION AND SUGGESTIONS

The results of the research that has been done indicate that the children are: (1) Able to name symbols of numbers 1-20, (2) Have the ability to use number symbols to count, (3) Able to match numbers with number symbols and recognize differences based on " more than"; "less than"; and "at most", (4) Able to group objects based on color, shape and size (3 variations), (5) Have the ability to sort objects by size from the smallest to the largest or vice versa, (6) Can estimate the next pattern after seeing the form of more than 3 consecutive patterns (7) Fulfilling errors in writing number symbols due to accumulation of information received by the brain. This happens because at the same time, the brain receives information in the form of Arabic number symbols and number symbols in general at once, (8) Activities numeracy literacy in the pandemic period for early childhood can still be done, one of which is by learning that involves the environment without eliminating the element of play but is still able to facilitate development. Suggestions that can be given from the results of this study are learning that provides optimal results must be able to generate interest in learning from children. he's a child. So it is hoped that parents and teachers can carry out learning that is able to generate interest in learning.

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