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The symbolic thinking ability of kindergarten students in central Aceh through Montessori games based on gender

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ABSTRACT

Student's cognitive abilities can be developed early, including thinking logically and symbolically and problem-solving using various methods. Therefore, this quantitative descriptive research aims to determine the symbolic thinking ability of kindergarten students through Montessori games based on gender. The subjects of this study were 112 kindergarten students from eight schools in the Central Aceh district who were selected by random sampling. Data processing techniques include editing, coding, scoring, and tabulation. The analysis was carried out using a frequency table with guidelines for assessing child development. Data were obtained from tests, observations, and interviews. Based on the analysis, it is known that the symbolic thinking abilities of male and female students are at the level of developing as expected. There are still students at the beginning to develop and undeveloped levels for both male and female students in this ability. There are differences in ability between male and female students, especially in indicators: i) Mentioning numbers 1-10 and ii) Counting and matching numbers with number symbols. While on the indicator of recognizing vowel and consonant symbols, there is no difference in ability between male and female students.

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1. INTRODUCTION

Education in human life has a very important position, especially at an early age, because all the major elements in humans are formed at that time, including all psychic abilities such as cognitive abilities. In the 21st century, children's cognitive and social abilities are important to pay attention to because children must be ready to face multiculturalism and the challenges of this increasingly advanced century [1]. Children's cognitive is a child's thinking process in remembering, classifying, and solving problems [2]. One of the cognitive abilities is symbolic thinking. According to Diane and Irani, it is the ability to think about symbols or imagine and represent objects that do not exist using symbols, numbers, or images [3]. This is in line with the opinion of Möhring, who said that in the symbolic stage, children manipulate symbols without depending on real objects [4]. In kindergarten children, the transition from mathematical thinking to abstract mathematical thinking helps their cognitive development and is also a requirement in learning basic arithmetic [5].

Based on observations and interviews conducted in several kindergartens in the Central Aceh district, it is known that students' symbolic thinking skills are still not well developed. There are six out of 15 children can mention numbers 1-10 but have not been able to match the numbers mentioned with the number of objects shown, and five out of 15 children can name vowels and consonants but have not been able to

match the letters mentioned with the words. While in other schools, data was obtained that there were four out of 12 children were able to mention the numbers 1-10 but had not been able to match the numbers mentioned with the number of objects shown. There were five out of 12 children could name vowels and consonants but had not been able to match them. Between the letters mentioned and the words shown. It can be concluded that 34-40% of the children in the two schools observed were able to name the numbers 1-10 but could not match the numbers mentioned with the number of objects shown. There were 38-42% of children who can say vowels and consonants but have not been able to match the letters mentioned with the words shown. This is due to inappropriate media in optimizing students' abilities and the lack of physical activity given to children so that their abilities are less developed. Developing children's symbolic thinking skills can be done by learning while playing, such as the Montessori learning method, which prioritizes the involvement of children's five senses in learning while playing. Montessori has been a successful method in the history of pedagogy since the 19th century [6]. Play has an important meaning for children because they are allowed to develop their potential and find their identity. In addition, playing is one of the ways children learn [7]. Through games, children's social, mathematical, and psychological abilities develop in a balanced way [2], [8]. Even in Turkey and Australia preschool curricula, play is an important activity in the learning process besides reading and writing [9].

In Montessori learning, the main component is children, while adults are tasked with preparing a communicative environment and supporting their need for independence [2], [10]. Montessori education aims to make children into full-fledged adults, emphasizing children's innate potential [11]. In Montessori, learning is carried out using special game tools such as educational games, which are expected to activate children's five senses so that their abilities can develop according to their age. The games created by Montessori for preschoolers focus on four areas (practical situations, early sensory, reading and writing, and arithmetic). By focusing on these areas, it is hoped that the competencies possessed by children can develop properly. Especially the abilities of boys and girls are not the same in several ways, one of which is cognitive abilities that can change and develop over time [12]. This study aims to analyze students' symbolic thinking skills in terms of gender through Montessori games.

2. RESEARCH METHOD

This quantitative descriptive study involved 112 Kindergarten students from eight schools in four sub-districts in Central Aceh Regency, Indonesia, namely Bebesen, Lut Tawar, Kebayakan, and Pegasing sub-districts. There were seven male students and seven female students selected from each school, respectively. The selection of schools and research subjects was made by random sampling. This study aimed to describe students' symbolic thinking skills through Montessori games in terms of gender. The instruments used in this study were: i) Tests in the form of Montessori games such as number blocks, number cards, letter blocks, letter cards, counting cards and tongs, colorful rice, and picture cards; ii) Student observation sheets; and iii) Student interview sheets with eight questions given when students play the game, and teacher interviews to determine students' abilities before being observed. Eight teachers were interviewed from schools who were the subjects of the study. There are three indicators of symbolic thinking ability seen in this study, as shown in Table 1.

Table 1. Indicator of symbolic thinking ability

Indicator	Indicator code	Game type	Descriptor	Descriptor code
Name the numbers 1-10	S1	Mention number symbols on blocks and number cards	Children can name the numbers 1-10 on the number block	S11
			Children can sort numbers 1-10	S12
Using number symbols to calculate and match numbers with number symbols	S2	Count the number of objects on the card and mark them with the help of tongs and number blocks	Children can count the number of objects listed on the card and determine the number using tongs and number blocks	S21
Recognize the various symbols of vowels and consonants	S3	Say the letter A-Z from the given letter blocks and cards	Children can name the letters A-Z from the blocks and letter cards given	S31
		Write some letters on colored rice by hand	Children can name and write the letters A-Z from the blocks, and letter cards are given	S32
			Children can name and write vowels and consonants	S33
			Children can group vowels and consonants from the given letters	S34
		Arrange the words on the cards using blocks and the letters A-Z	Children can string words on the cards using blocks and letter cards A-Z	S35

This study's data processing techniques include editing, coding, scoring, and tabulation. The data obtained from the student's symbolic thinking ability test through the Montessori game was assessed using a child development assessment guide which was analyzed using (1) [13]:

$$X\% = \frac{n}{N} \times 100\% \quad (1)$$

Description:
X% = searched percentage
n = number of abilities acquired
N = max score

3. RESULTS AND DISCUSSION

The data were collected twice through observations one and two. When children were observed, they were also interviewed to determine how their symbolic thinking skills developed through the games provided. Then students are grouped based on their ability level, such as developing very well (DVW), developing as expected (DAE), starting to develop (SD), and not developing (ND). Based on the analysis results using child development assessment guidelines, it is known that the symbolic thinking ability of kindergarten students in Central Aceh Regency is at the level of developing according to expectations, as shown in Figure 1.

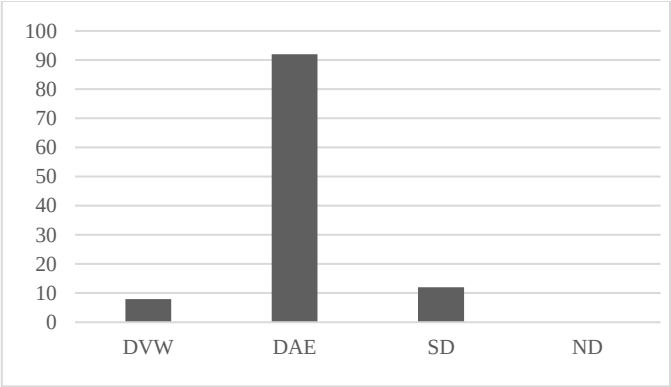


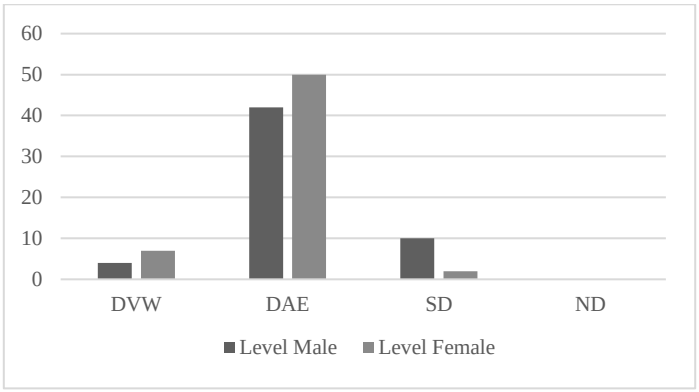
Figure 1. Level of symbolic thinking ability of kindergarten students in central Aceh district

In Figure 1, it can be seen that students can carry out activities related to symbolic thinking. However, they are not very fluent and still need help from the teacher to help them find the correct answer for each activity carried out. While the symbolic thinking ability of students is grouped by gender and indicators, it can be seen that there are differences in abilities between male and female students in several indicators. The data can be seen in Table 2 and Figures 2 and 3.

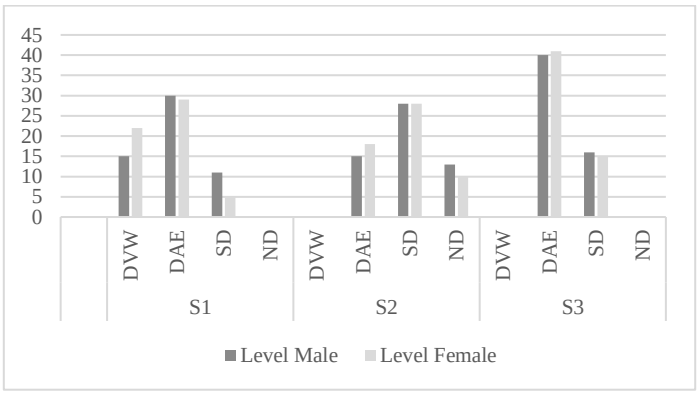
Table 2. Symbolic thinking skills based on indicators and gender

	Indicator	Level	Man		Female		Total	
			f	%	f	%	f	%
1	Name the numbers 1-10	DVW	15	26.79	22	39.29	37	33.04
		DAE	30	53.57	29	51.79	59	52.68
		SD	11	19.64	5	8.93	16	14.29
		ND	0	0	0	0	0	0
2	Using number symbols to calculate and match numbers with number symbols	DVW	0	0	0	0	0	0
		DAE	15	26.79	18	32.14	33	29.46
		SD	28	50.00	28	50.00	56	50.00
		ND	13	23.21	10	17.86	23	20.54
3	Recognize the various symbols of vowels and consonants	DVW	0	0	0	0	0	0
		DAE	40	71.43	41	73.21	81	72.32
		SD	16	28.57	15	26.79	31	27.68
		ND	0	0	0	0	0	0

In Figure 2(a), it is known that the abilities of male and female students are generally at the level of developing as expected. It can be seen that there are more female students than male students. While in Figure 2(b), it can be seen that female students' ability is better than male students, especially in the indicator mentioning the symbols of numbers 1-10 and using number symbols to calculate and match numbers with number symbols. The following is an analysis of observation data 1 and 2 based on gender, indicators, and descriptors.



(a)



(b)

Figure 2. Level of symbolic thinking ability of kindergarten students in central Aceh district based on (a) gender and (b) indicators and gender

3.1. Female subject

Based on the analysis results of the observations of one and two female students, the following results were obtained. In the aspect of mentioning numbers 1-10, it appears that students can mention numbers 1-10 on blocks and number cards very smoothly without help from the teacher. It can be said that the student's abilities are at a very well-developed level. While in the aspect of sorting numbers from 1-10, the subject seems to have been able to sort them even though they are not too fluent in doing so. The subject misplaced two numbers out of place, so the teacher asked questions to help the subject correct his mistakes. Students' ability in this aspect is at the developing level as expected. Using number symbols to count, students have been able to do it even though they are not fluent. The subject seemed to have difficulty when asked to match the number of objects counted with the number symbol. For numbers 6 and 9, the subject always made mistakes in placing the numbers, so the teacher gave several questions to direct the subject to correct his mistakes. Students' ability in this aspect is at the level of beginning to develop.

In the aspect of mentioning the letters A-Z and assembling the written words on the picture cards given by the teacher, the subject could do it smoothly without the teacher's help. Students' abilities in this aspect are at a very good developing level. In the aspect of mentioning the letters A-Z according to the cards and blocks given, the subject can pronounce them well even though they are not very fluent and still need the teacher's help for a mistake made. Likewise, with the aspect of writing letters on the color rice provided, the subject seems to have been able to do it, although not yet fluently. Students' ability in this aspect is at the

level of developing according to expectations. As for the aspect of mentioning vowels and consonants, writing them on colored rice according to the letters shown, as well as grouping vowels and consonants according to the instructions, it seems that the subject has started to be able to do it even though it is not fluent and still needs help from the teacher. There are still some missing letters for vowels and consonants. Students' ability in this aspect is at the level of beginning to develop.

3.2. Male subject

The following results were obtained based on the analysis results on observations of one and two male students. In the aspect of mentioning the numbers 1-10, both from the number blocks and the number cards given, the subject can pronounce them fluently without the teacher's help. Students' abilities in this aspect are at a very good developing level. Meanwhile, in sorting numbers 1-10, the subject has not been able to do it. Subjects do not know all the symbols of numbers, so they have difficulty sorting numbers. The ability of students in this aspect is at a level undeveloped. In the aspect of using number symbols to count, students have been able to do it smoothly without being assisted by the teacher, but the subject seems unable to match numbers with their symbols. After counting the number of objects, the subject does not know which pins and number blocks to put on the given card. So, the teacher asks questions to help students remember how many numbers are needed to solve the problem. The ability of students in this aspect is at a level undeveloped.

In the aspect of mentioning the letters A-Z, it can be seen that students can pronounce them fluently without help from the teacher. Students' abilities in this aspect are at a very good developing level. In the aspect of mentioning the letters A-Z according to the cards and blocks given, the subject has started to be able to do it, although there are still some letters that do not match the number symbol in pronunciation. However, to mention vowels and consonants and group them according to their respective groups, the subject has not been able to do it. The subject does not know which letters are vowels and consonants. The ability of students in this aspect is at the level of undeveloped. as for assembling the words contained on the card using blocks and letter card A-Z, the subject is starting to be able to do it with help from the teacher because some letters are misplaced and are not sorted according to the text given. After being assisted by the subject, the teacher can fix it. Students' ability in this aspect is at the level of beginning to develop. This section will present the results of interviews with the subject H2. For indicators mentioning the symbols of numbers 1-10 and using number symbols to calculate and match numbers with number symbols, the following is a snippet of the results of the subject's interview:

P : *Assalamualaikum, today we are playing with numbers again but with cards like this. Can you count from 1 to 10? I want to hear you count.* (S11)
H2 : *Yes, I can, mom (counting from 1 to 10 smoothly)*
P : *That's great. Now, try to help me, by sorting these numbers from 1 to 10.* (S12)
H2 : *Ok, mom (sorted numbers 1 to 10, but misplaced numbers 6 and 9)*
P : *Let's try to calculate it. 1, 2, 3 (counting from 1 to 10) Is this one correct?*
H2 : *It's 6. Mom (says the number 9 is 6)*
P : *Take a look again; isn't this the reverse?*
H2 : *Yes, it's upside down. I'll fix it first (correct the location of numbers 6 and 9)*
P : *Now let's change the game. I have a butterfly card. Let's try to count the number, then we put the numbers in this empty box (shows a card containing butterflies and asks students to count the number).* (S21)
H2 : *This is ma'am (counting the number of butterflies and putting the number 8 on the card)*
P : *Let's count together again. How many butterflies are there?*
H2 : *Uh, the 7 butterflies. Which number is it? this one, mom? (takes the number 7)*
P : *Good, here are the numbers. If this card? Try to do it.*
H2 : *There are 9 pieces of fish (put the number 6)*
P : *It's good that there are 9 fish, but is this number correct? Is this number 9?*
H2 : *Yes mom*
P : *Then which one is number 6?*
H2 : *This is wrong. I always forget (correct the numbers on the card)*

For indicators of recognizing various symbols of vowels and consonants, the following is a snippet of the results of the subject's interview:

P : *Now let's continue with playing the letters. Can you say the letters A-Z?* (S31)
H2 : *I can see mom (says the letters A-Z but forgot to mention the letter P)*
P : *There's something you forgot. Let's try again (repeat together)*

H2 : *I forgot the letter P*
P : *Very good. Can you help me now, what kind of letter is this? (while showing the letter T and asking the child to say what letter it is). Try writing this letter on this colored rice by hand, can you? (shows how to write letters on colored rice and asks the child to write the designated T)* (S32)
H2 : *Yes, I can, mom (write the letter I)*
P : *Look again, what was that letter?*
H2 : *Letter T mom*
P : *Is it the same as what you wrote?*
H2 : *Like this, mom? (write plus)*
P : *Now try to pay attention (shows how to write the letter T)*
H2 : *(trying to write it)*
P : *That's right, that was the letter I. Continue with the other cards*
H2 : *Ok mom*
P : *Now can you name the vowels?* (S33)
H2 : *I can't, mom*
P : *A, I, U, E, and O, are vowels. Do you know the consonants?*
H2 : *A B, C, D*
P : *Consonants are other than vowels.*
H2 : *I'm not a good mom*
P : *Let's try together (Together, say the consonants). Now can you write the letters A and D on this colored rice?*
H2 : *I can see mom (write the letters A and D on colored rice with the help of the teacher)*
P : *Thanks. Now I have many letters here. I need your help to group them into groups of vowels and consonants. Can you help mom?* (S34)
H2 : *I cannot, mom*
P : *Let us try together. Can you see if this is a vowel or a consonant?*
H2 : *The vowel mom (designates a consonant as a vowel)*
P : *This is a consonant. Let us try it together.*
H2 : *Ok mom*
P : *Very nice. Now let us see, what picture is this? (shows a bicycle card)* (S35)
H2 : *A bicycle mom*
P : *Good, this is a bicycle, and this reads BICYCLE (read the word under the picture of the bicycle). Can you help me put together the word bicycle? We look for the letters here, then arrange them like this card.*
H2 : *I can, mom. Are we looking for the letters here, mom?*
P : *Yes, what was the first letter?*
H2 : *The letter S (find and string letters)*
P : *Is this one correct? Let us see again what letter after the letter P? (subject puts the letter A after P and the letter E after D)*
H2 : *After P, the letter E. I misplaced it mom (fixed the work)*
P : *Very good. This reads BICYCLE. Now you continue with another card.*
H2 : *Ok mom*

In seeing symbolic thinking skills, students are trained by using Montessori games that involve several senses, where the five senses are the gates of knowledge to the brain. The child's five senses will be trained [10]. Therefore, they must have the same opportunity to develop according to their function. In symbolic thinking skills, the game is more focused on the areas of writing, reading, and arithmetic. In helping the development of children's abilities, play has an important role, such as i) Motoric, children learn to write or draw geometric shapes; ii) Cognitive, symbolic play can improve children's cognitive abilities, especially in preschool which can encourage children's creative thinking skills; and iii) Socially and emotionally, playing can improve the ability to interact and communicate between children which can encourage the formation of friendship relationships. Playing is one of the best strategies for stimulating children's cognitive and emotional development [14], [15]. The symbolic thinking ability of students is marked by the ability of students to recognize symbols from the numbers and letters they learn. Not only abstract forms of symbols of numbers and letters, but also concrete forms or symbols of numbers and letters. In this case, the teacher must be more creative in learning because direct interaction with teaching aids by introducing them to numbers and words can provide a concrete foundation for students to help their abstract knowledge [3]. Children aged 5-6 years are at the stage of pre-operational thinking development, where children enter the process of

symbolic thinking by mentally imagining an object that does not exist. Students' early mathematics is the main concern of teachers in kindergarten schools because there is a very close relationship between initial mathematical knowledge and advanced mathematics that they will learn at higher education levels [16].

To help students develop their ability to name the symbols of numbers 1-10, the games used are blocks, number cards, and colored rice. This game focuses on the arithmetic area. According to Gerosa *et al.* [17], there are four stages of cognitive development of children, namely: i) Sensory-motor (age 0-2 years); ii) Pre-operational (2-7 years); iii) Concrete operations (7-11 years); and iv) Formal operations (11 years and over). Based on this opinion, kindergarten students are in the pre-operational stage. In recognizing the concept of number symbols, children need concrete objects that children can use in the learning process. This is supported by a research [18], stated that children aged 3 to 6 years are more interested in and easy to understand learning to count through concrete objects around them. Utilization of these concrete objects can help them recognize the concept of numbers better because they can feel and feel the object directly without imagining abstract objects. This is in line with previous study [19], stated that children can learn concrete number concepts with number recognition. They can experience how the numbers 1 to 10 form by looking at them and fingering the number one itself. In addition to using number blocks, writing the shapes of numbers on colored rice can also help students see and feel the shape of the number symbols 1 to 10. By doing repetitions to introduce numbers 1 to 10 using the game tool, it can help teachers improve their ability to recognize symbols. numbers and is an early stage for them before starting to write.

Based on the analysis results, female students' ability is better than male students on the indicators of mentioning numbers 1-10 and putting them in order. These results are in line with Setiawati, Ali, and Yuniarni [20], wherein research found that the ability of female students to sort numbers was better than male students. This is because female students can sort numbers better than male students. Ulger and Morsunbul also said that girls' ability was better than boys [12]. In the indicator of counting and matching numbers with the symbols of the numbers, the games used are number blocks, counting cards, and color clamps. This game also focuses on the arithmetic area of the Montessori game. There is a difference in the ability to calculate and match numbers with number symbols between male and female students, although it is not too significant from the analysis obtained. This result contradicts the opinion [20], which stated that girls in quantitative and visual-spatial abilities have not been able to exceed boys. This is because men's brains can concentrate on one specific thing, and they have a smaller perspective than women.

In the aspect of using number symbols to count, male students are seen when asked to count and match the number of objects with the number symbol; they do this by counting out loud and then determining the number symbol that matches the number of objects that have been counted. When the number of objects is more, students look a little hesitant and repeatedly count the number of objects so that they are not wrong in determining the number symbol. Meanwhile, female students were calmer when carrying out the instructions given by the teacher. Students count in a low voice and match the number of objects with the number symbol. Although they have different ways of counting and matching number symbols, their abilities are not much different, and only the process is different. This happens because their brain development is different, which indirectly affects their ability to count, especially by matching objects with number symbols [20]. Papadakis, Kalogiannakis, and Zaranis [21] stated that there may be differences in the counting process based on gender differences influenced by external and internal factors of each individual. In addition, there was a significant difference in children aged four years in understanding written number symbols.

Students were trained to recognize symbols from numbers 1 to 10 using number blocks in the previous indicator. Then the next step is to help them match the number symbols with the number of objects on the cards that have been provided. It is a foundation for students before they learn from the concrete to the symbol. When they have mastered basic arithmetic by matching the number symbols and numbers requested, they will later find it easier to learn other mathematical concepts. According to Suryatin and Sugiman [22], the concept of mathematics for early childhood is a process of connecting objects and the concept of numbers. Praet *et al.* [23] stated that to introduce symbols to students, several stages can be done by teachers, namely: i) One-to-the-one correspondences, where children recognize number symbols by matching one item to another. The child mentions number 1 and shows the blocks from number 1 onwards; ii) Rote counting, by repeating and practicing numbers to help children understand the meaning of the number; and iii) Rational counting, by counting the number of objects and sticking blocks/number cards that match the number of objects so that they understand the meaning of the number.

If the child is sensitive to counting, then parents and teachers should provide basic knowledge of arithmetic to get children used to thinking about solving simple problems around them because some children have difficulty transforming concrete mathematical problems with mathematical symbols [24]. Playing using number blocks is proven to be very effective. It has a positive effect on student's cognitive abilities, in line with the opinion [23], which says that students' ability to recognize numbers can be helped to develop optimally by playing number blocks. This is also in line with research [6] stated that Montessori games can help develop children's motor, sensory, and mathematical skills. In addition, the intelligence and skills of

students in both mathematics and social fields who are taught using the Montessori method and games are proven to be substantially higher than students who are taught using the traditional method [25], [26].

To help students develop their ability to recognize vowel and consonant symbols, the games used are block and letter cards, colored rice, and picture cards. This game focuses on the area of reading and writing. In mentioning and writing letters and grouping them according to the letters given, both male and female students are at the developing as-expected level. There is no difference in ability between male and female students on this indicator. This result is supported by [27], [28], which said that there is no significant difference in recognizing letters, reading, and writing between male and female students. According to Mascareño *et al.* [29], learning to recognize letters is an absolute must in developing children's reading and writing. They must know the alphabet to read and write fluently later. Compared with children who lack mastery of the alphabet, those who first understand the alphabet are much more independent and do not experience difficulties in learning. Because introducing letters to children from an early age can support the improvement of children's language [30]. This is in line with the research by Mascareño *et al.* [29], who said that children's reading skills will be better if they recognize letters well from an early age.

We can use many media to help students develop their ability to recognize letters A-Z, one of which is letter cards and picture cards. The ability to recognize letters is one aspect of a child's language, so it needs optimal stimulation from an early age. This is the opinion of Lestari [30], which stated that giving letter recognition stimulation can stimulate children to remember, understand, and use written symbols to communicate. In addition, Lestari also said that one of the most effective playing methods used is the letter card game in helping to improve the ability to recognize letters through concrete objects [30]. In addition to letter cards, picture cards containing the text under the picture can also help students develop their abilities. Cards containing pictures and writing can help develop children's intellectual and memory skills [26]. Image and color media make them more interested and make the learning process more fun and easy [31].

Differences in abilities possessed by male and female students are influenced by several factors, including heredity and environmental factors. Gender, environment, and family social status can also affect children's abilities [32]. Parents' intelligence, nutrition, environmental conditions, facilities, and interpersonal relationships with children can affect their intelligence and abilities [25], [33]. This is supported by the opinion [34] stated that social experiences such as interactions between parents and children greatly affect children's cognitive development. In addition, the teacher or school environment also affects the development of children's abilities. Close relationships between teachers and students and a conducive learning environment according to children's needs can help develop children's creativity and abilities, such as logical and symbolic thinking skills [35]–[37]. For this reason, further research is also needed to improve students' cognitive abilities, such as the ability to think logically.

4. CONCLUSION

Based on the previous analysis, it can be concluded that the symbolic thinking ability of male and female students is at the level of developing according to expectations. There are still students at the beginning to develop and undeveloped levels for both male and female students in this ability. This means that a very large role from the teacher is still needed to help students develop students symbolic thinking skills. There are differences in ability between male and female students, especially in indicators: i) Mentioning numbers 1-10 and ii) Counting and matching numbers with number symbols. While on the indicator of recognizing vowel and consonant symbols, there is no difference in ability between male and female students.

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