

The Implementation of Scientific Literacy in Enhancing Scientific Thinking Ability for Early Childhood

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Abstract: This article aimed to obtain and to analyze the differences scores of scientific thinking ability between the children whom got the scientific literacy learning and classical learning. The background of the study is the lack of science activities in early childhood education due to several things: (1) Teacher competency towards knowledge of science concept; (2) Some teachers have not comprehended about planning and developing science activities, organizing learning environment, and devoting support to children in playing activities of science; (3) The lack of knowledge about scientific thinking ability of early childhood. It used quantitative approach with a quasi-experimental design. It was conducted at RA Nurul Huda, Bandung that involved 30 children, aged 5 to 6 years old, which divided into two classes, control and experiment. The data were obtained through questionnaire and it was analyzed by Independent Sample t-Test method. The results showed that there was a difference score between two classes towards scientific thinking ability of scientific literacy implementation since the p-value (0.00) is less than 0.05 and the average of N-Gain of experiment class (133,503) is greater than control class (130, 169). In conclusion, the implementation of scientific literacy is able to enhance the scientific thinking ability of early childhood. For further studies, scientific literacy implementation might be developed to discover and to improve the critical thinking of early childhood.

Keywords: *scientific literacy, scientific thinking ability, early childhood*

INTRODUCTION

Industrial of revolution 4.0 encourages people to do a collaboration among things, for instance science and technology. People should be well-known to scientific things. Children should be prepared to face the world and are able to compete globally in many sectors. The way to think of children is more critical and more scientific to solve obstacles and to prove some evidences related to science activities. Therefore, scientific literacy might be one of the ways to elucidate obstacles in order to discover resolution, how and what should be prepared to generate the best generation.

Scientific literacy is a part of science which is practical and it is related to scientific issues and ideas. Science of early childhood consists of knowledge, facts or natural phenomena and those are valuable for their daily life. Thus, it might provide new experiences and knowledge from observation and experiments directly that have been done by the children. In Early Childhood Education (ECE), activities of science will integrate the concept of knowledge and scientific thinking of early childhood.

The basic principle of scientific literacy includes contextual learning that is adjusted to local wisdom and globalization. It provides positive contributions for early childhood, for instance children are able to participate directly into the learning activities and they may implement the knowledge into their daily life. This is in line with Pinter (2006) stated that contextual learning will provide more significant meaning, specifically for early childhood learning. In addition, scientific literacy might be applied to fulfil social needs, cultures, nationality, and country. In ECE, collaboration could be done by children with teachers, parents, peers, and experts. For instance, a teacher asks children in a group to do an experiment, such as volcanic eruption. This

experiment conducted by mixing baking soda and vinegar. This activity shows that the collaboration between a teacher and children. It also supports children to be more active since they do the experiment directly and cooperate each other (Ministry of Education and Culture, 2017).

Thinking is an activity to process, to use information, to find out the reasons, to do reflection, to evaluate ideas, to solve problems, and to make decisions (Santrock, 2011). This process has been experienced by the children which is classified into three stages. They are infant, children, and adult. In ECE institution, the children who are in kindergarten, aged four to six years old, should be given active stimuli to facilitate them to think critically and scientifically, and problem-solving skill.

There are several ways to make the children think critically and to practise how to solve the problems. The way how the children think related to scientific phenomena is scientific thinking. For early childhood, literacy activities which have been done in kindergarten may accommodate children's needs, particularly their curiosity about natural phenomena like a scientist. However, there are differences between children and scientists' ideas (Abruscato & DeRosa, 2010). For instance, children build their concept about something without experiencing natural phenomena, then a phenomenon can be proved scientifically, thus they tend to preserve their theory which has been constructed (Kuhn, Schauble, & Garcia-Mila, 1992 dalam Santrock, 2011). Based on this phenomena, a teacher is able to give an explanation properly regarding to science through simple words, therefore children can process the information and construct the scientific thinking appropriately. In line with this, Lehrer and Schauble (2006 as cited in Santrock 2011) believed that a child seems similar with a scientist due to a high curiosity. Contrary, the way they think is different. The scientific thinking ability between a child and a scientist has a difference, specifically the way to separate theory and evidence. In addition, the difference can be found in designing a conclusive experiment.

There are stages of scientific thinking for early childhood. First, problems or questions come from children due to their curiosity. Second, experiment to prove phenomena in a real way. Third, combining children's theory that has been constructed and new information from experiments. In activity, a teacher could confirm a certain theory if there is a mistaken concept or theory from the children. It is aimed to strengthen the correct children's theory which is completed by actual evidences. In a result, children are able to present the experiment's results fluently.

According to Curriculum ECE 2013, the activities of science include the children's ability of thinking process which is developed, as follows: (1) The skill to observe; (2) The skill to categorize; (3) The skill to measure; (4) The skill to present what they learned.

According to observation conducted in some ECE institutions, it was found that the activity of science was inadequate since the institution did not provide chances for children to get new experiences and to interact to environment. Those occurred due to several reasons, as follows: (1) Teacher's competency related to knowledge of science concept; (2) Some teachers have insufficient knowledge to plan and to develop activities of science, to organize environment and to support children on science play activities; (3) Some teachers have inadequate knowledge about scientific thinking skill of early childhood.

In learning practices, a teacher is able to integrate scientific literacy activities into children development aspects, as like as arts. Children comprehension related to science could be visualize into artworks or art projects, such as drawing. The artworks or art projects can be assessed as an evaluation to identify their comprehension of that learning activity.

Several present studies related to the theories above showed that the countless activities of science will encourage children to be more active and are able to enrich themselves of contextual learning experiences (Yilmaztekin & Erden, 2016; Kermani & Aldemir, 2015). The activities of scientific literacy in ECE can be collaborated with children development aspects which can promote their development optimally. Moreover, natural phenomena may provide opportunities to construct the children’s concept based on what they see spontaneously and unintentionally. Uncovering this phenomena, teacher should facilitate and accommodate children’s concept into learning activities (Kuhn, 2011; Magnusson & Palinscar, 2005 dalam Santrock, 2011). Furthermore, an effective learning activity of science might reduce misconception and replace a certain concept with another one which is accurate (Van der Brock, 2010).

According to background above, this article aimed to discover difference and impact of scientific literacy to scientific thinking skill of early childhood, aged five to six years old, between two groups, the children who did the science activities and those who did the classical activity in kindergarten.

METHOD

This study used quantitative approach which presents the factual quantitative data or numbers and things that can be counted (Sugiyono, 2008). It used quasi experiment, aimed to discover roles of scientific literacy toward children’s scientific thinking ability. This design has been chosen since the researcher used the groups which were available (Sukardi, 2003). It involved 30 children which were divided into two classes; 15 children were in experiment class and 15 children were in control class. The data were gathered through observation sheet that included 47 indicators related to scientific literacy. The data were analyzed by SPSS.

RESULTS AND DISCUSSION

Results of Research

General Description of Pre-test of Scientific Thinking for Early Childhood (5-6 years old)

Based on the research, the general description of pre-test related to scientific thinking of 15 children, aged five to six years old that has scale 1-4, as follows:

Table 1. Test of Normality of Pre-test

Class	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Scientific thinking Experiment	,169	15	,200 [*]	,896	15	,083
Control	,186	15	,175	,913	15	,152

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

That data showed that experiment class has significance value 0.200 and control class is 0.175. The data from two classes have normal distribution since each significance value is greater than 0.05. Then, it was continued to test of homogeneity of variances, as follows:

Table 2. Test of Homogeneity of Variances of Pre-test

Scientific thinking				
Levene Statistic	df1	df2	Sig.	
1,680	1	28	,205	

The table showed that the data were homogenous since the significance value, 0,205, is greater than 0.05.

The requisites were fulfilled. Then, the data would be processed by using T-test. It was used to reveal the difference scientific thinking of early childhood between two classes. They are control class (classical method) and experiment class (scientific literacy method).

The T-test was utilized, can be seen below:

Table 3. Independent Samples Test of Pre-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Scientific thinking	Equal variances assumed	1,680	,205	,292	28	,772	1,067	3,653	-6,417	8,550
	Equal variances not assumed			,292	26,272	,773	1,067	3,653	-6,439	8,573

The table above showed that the value of scientific thinking ability in the experiment class is 0.722, whereas in the control class is 0,733. That was not a difference between two classes regarding to scientific thinking ability.

General Description of Post-test of Scientific Thinking for Early Childhood (5-6 years old)

The results of post-test can be seen below:

Table 4. Test of Normality of Post-test

Skill Class		Kolmogorov-Smirnov ^a			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Scientific thinking	Experiment	,124	15	,200*	,925	15	,230
	Control	,143	15	,200*	,956	15	,620

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

The data showed that the significance value of experiment class is 0.200, whereas the control class is 0.200. The data of two classes have a normal distribution. Then, the data were processed to count the homogeneity of variances, as follows:

Table 5. Test of Homogeneity of Variances of Post-test

Scientific thinking				
Levene Statistic	df1	df2	Sig.	
1,433	1	28	,241	

The table showed that the data were homogenous since the significance value, 0,241 is greater than 0.05.

The requisites were fulfilled. Then, the data would be processed by using T-test. It was used to reveal the difference scientific thinking of early childhood between two classes. They are control class (classical method) and experiment class (scientific literacy method). The T-test calculation can be seen below:

Table 6. Independent Samples Test of Post-test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Scientific thinking	Equal variances assumed	1,433	,241	-4,202	28	,000	-13,867	3,300	-20,627	-7,106
	Equal variances not assumed			-4,202	26,529	,000	-13,867	3,300	-20,644	-7,089

The table above showed that the value of scientific thinking ability for each class is 0.000. That was a difference between two classes regarding to scientific thinking ability. It can be seen through N-gain. The N-gain of experiment class is 133, 503, whereas for control class is 130, 169. By looking at the N-gain of experiment class, the scientific literacy affected scientific thinking of early childhood.

Discussion of Research

Scientific Literacy Learning Design

The implementation of scientific literacy for early childhood should be done with several stages, as follows:

1. Theme and sub theme mappin in one week:
The theme is “Negaraku”. The sub themes are Indonesian islands, traditional houses, nationality, cultures, rural and urban areas.
2. Scientific literacy materials and activities include:
 - Identify Earth’s crust (sand, soil, and rock)
 - Identify materials of traditional houses, such as rattan and bamboo
 - Identify various skin tones
 - Identify photosynthesis process
 - Identify natural phenomena, as like as rain, landslide, and liquefaction
 - Identify various tastes of traditional dishes form West Java.

3. Learning indicators can be seen below:
 - Observing (earth's crust, materials of traditional houses, skin tones, leaves, and natural phenomena)
 - Comparing (dried leaves and green leaves; drizzling and raining, minor earthquake and mayor earthquake)
 - Grouping (sweet and salty, textures, etc)
 - Measuring (sand and water)
 - Communicating (cause and effect of natural phenomena)
4. Media and tools, for instance encyclopedia books about nature, pictures, natural materials, plastic aquariums, dishes from West Java
5. Evaluation: The instrument used scale 1-4 which are BB (undeveloped), MB (began to develop), BSH (developed), and BSB (developed well). The data from each student were gathered through observation and portfolio.

Scientific Literacy Implementation

During the implementation, children followed the learning activities classically at the opening and closing, for instance praying, reciting salam, doing Shalat Dhuha, and singing together. In the main activities, the children some scientific activities, as follows:

Table 7. Scientific Main Activities

Day and Date	Learning Activity	Learning Indicator
Monday, 22 April 2019	Children search for soil, rock, and soil around the school	Children were excited and enthusiastic to observe and to count rocks in increasing their curiosity
Tuesday, 23 April 2019	Children identify the materials of traditional houses, as like as rattan and bamboo with its usefulness	Children involved in learning activities by observing shape and texture of rattan and bamboo
Wednesday, 24 April 2019	Children identify the process of photosynthesis through videos, distinguish dried and green leaves, and create a crown of dried leaves	Children were enthusiastic to observe photosyntheses, they can distinguish dried and green leaves properly, and they were excited to create a crown of dried leaves as one of traditional accessories
Thursday, 25 April 2019	Children observe and distinguish skin tones through pictures	Children were enthusiastic to look at the pictures which showed some skin tones for each Indonesia region
Friday, 26 April 2019	Children identify and tasting some traditional dishes of West Java	Children recognized several flavors as like as salty, sweet, and spicy following with the textures, soft, tender, crunchy, and sticky
Monday, 29 April 2019	Children identify rain process through pictures and songs	Children actively involved in practical activities of rain process
Tuesday, 30 April 2019	Children observe the process of liquefaction through videos and observe demonstration about liquefaction using aquarium and sand	Children were excited to watch the video of liquefaction and enthusiastically did the simulation of liquefaction
Thursday, 2 Mei 2019	Children observe and slide through demonstration which used aquarium and sand	Children distinguished effects of soil condition which planted of trees and unplanted of trees

CONCLUSION

According to the explanation above, the researchers conclude that the implementation of scientific literacy in ECE needs learning activities which provide direct experiences, tangible media, and utilization of natural material around school, thus it assists and supports children to enhance scientific thinking for early childhood, specifically five to six years old. Furthermore, the findings are able to be references for teachers to develop the scientific literacy through contextual learning based on needs and interests of children. This study can be continued by implementing scientific literacy which can improve children's critical thinking.

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