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The Early-Year Children's Engagement and Scientific-Phenomena Recognition in Indonesia

Susi Hindarti[1], Urip Sulistiyo[3], Afreni Hamidah[4], Muhammad Haris Effendi-hasibuan[5*]

[1]*Graduate Program of Universitas Jambi*
[2345]*Faculty of Education and Teacher Training, Universitas Jambi*
[*]*Corresponding author. Email:hariseffendi@unja.ac.id*

ABSTRACT
Developing the early-year children's engagement is crucial to promote their interest in learning, particularly in the science-related lessons. This article reports about the engagement of 15 early-year children in a childhood education program in Jambi city Indonesia and their recognition of some scientific phenomena discussed during the lesson. A classroom case-study research design was used to collect data. The children were involved in talking about daily scientific phenomena using a question and answer (Q&A) method in four meetings for 60 minutes each. The data about the children's engagement during the lessons were collected using the Gutman-style classroom observations and the data about the science recognition of the children were collected from the voice-recorder-assisted classroom dialogues. The data about the children's engagement were analyzed using a quantitative method while the data about the children's science recognition were analyzed descriptively. The results showed that the children's participation increased during the lessons that encompass the aspects of listening to the teacher, answering and posing questions, and sharing personal interest. The results also revealed that the children had recognized six scientific phenomena that included the phenomena about pointed objects, air, water, temperature, mirror, and wings. These results inferred that the engagement of the early-year children can be enhanced by using the Q&A activities and involving them in a scientific-driven dialogue. These results also inferred that the early-year children had been aware about and recognized some scientific phenomena which were pre-existed in their daily life that need to be furtherly developed in class using appropriate teaching methods.

Keywords: *early-year childreen, engagement, Q&A, science recognition*

1. INTRODUCTION

The term of early-year children involves kids who are aged from birth to six years old. This six-year duration -the so-called early-year childhood- is a golden period for children to have opportunities developing all aspects of their life competencies. This golden period only lasts once throughout the span of their life, therefore, should have taken much attention from adults, parents, teachers, and authorities. Every child should be given rights to spend his/her childhood in a proper way, including a formal early-year educational pathway. In Indonesia, the early-year childhood education (Pendidikan Anak Usia Dini or PAUD in bahasa) is a formal educational program mandated by the Law of Indonesia Educational System No. 20 of 2003 and administered by authorities with one purpose to grow the children's physical and spiritual readiness to enter further educational levels. This law mandates that the program must be well-prepared and administered in a holistic manner [1].

Kindergarten is a kind of PAUD in the formal educational pathway that organizes educational programs for children aged 4-6 years old. One scope of the kindergarten curriculum covers the development of children's basic skills, and this includes the aspects of cognitive development. One of the goals to develop the cognitive aspect is to enhance children's knowledge about science. Rahman [2] said that the purpose of PAUD is to promote children to have scientific knowledge and abilities that include the abilities to provide reasons and to find scientific causal relationships.

Besides aiming to foster early-year children's knowledge and ability in science, learning in PAUD also aims to facilitate early-year children to be more interested in science. For this, children need to be

engaged to actively seek information about science, particularly those that are pre-existed around them. This goal can be achieved by involving the children to do observation and investigation to collect data. This activity will foster their scientific awareness and curiosity [3]. Therefore, science needs to be introduced to the early-year children from the very beginning. This is why more attention needs to be paid by parents, teachers, and authorities to promote the scientific knowledge of the early-year children that in turn will improve the quality of science education in Indonesia [4].

Given the importance of introducing science to young children, thus this teaching activity should have been adopted by teachers in their routine tasks. However, science teaching activities in primary education programs, including PAUD, have been minimal. Based on our anecdotal evidence in some PAUD in Jambi city Indonesia, it was seen that the portion of some teacher's daily teaching topics between science contents and non-science contents has been unbalanced. Teachers mostly talked about religion, moral, civics, and national philosophy. They dominantly told the children about how to be a good citizen with good characters. All those topics are indeed important for the children in their life, yet are not enough for the children to be a science-aware citizen who is knowledgeable, rational, and tends to use scientific reasons in making decisions in life [5]. This is why creating science-aware children has been a big burden for the childhood education program [6]. On the other hand, even though the PAUD teachers – in some occasions – talked about science, they often bounded to textbooks and/or worksheets. The science concepts taught to the children sometimes tend to be rigid, do not meet the children's cognitive ability, and even exclude the children's daily experience [7], [8]. In fact, a good science teaching activity is a teaching activity that relates science concepts to children's life. At this point, it is seen that early-year children need to be involved in science activities that engage them to be more active in seeking scientific phenomena from their life.

Aiming to introduce science to early-year children, therefore, teachers need to use an appropriate teaching method that meets the children's cognitive ability and interest. This is important to promote the children's engagement during the lessons and to enhance their active participation in talking about science. One of the teaching strategies that can be used to enhance children's engagement in a science classroom talking about scientific phenomena is the question and answer (Q&A) method.

The Q&A method is a learning process in which a teacher and children have some dialogues about a certain topic-to-learn. In this activity, the teacher normally invites young children to answer questions about scientific phenomena, and at another occasion the children pose questions and the teacher provides answers to the children. The children may use their personal understanding and life experiences to provide the answers. This activity is highly demanded to develop the children's ability to speak as this activity provides the children opportunities to express their ideas and opinions. In addition, the children also have opportunities to rehearse vocabularies and listen to other children's answers [9]. In that learning atmosphere, the children's attention to the science contents will increase, and that will further increase their engagement in such learning activities. In this study, therefore, the Q&A method had been used to promote the engagement of early-year children to talk about simple scientific phenomena they naturally recognized.

According to the national science education standards, science learning for early-year children should be able to nurture children's science ability, particularly the ability to recognize scientific phenomena around them. Children need to be aware of scientific phenomena that existed in their life. Teachers should promote children's encouragement to explore materials. Teachers need to provide direct experiences to children to interact with materials that include activity to formulate scientific questions, to predict, to investigate, to estimate, to classify and to find concepts. This is the role of science learning as inquiry which involves children as young scientists in classrooms [10].

Similarly, Nugraha [11] stated that science learning for early-year children should also be helpful for children to be able to 1) recognize the science as products that includes the ability to understand facts, concepts, principles, laws and theories; 2) realize the science as process that includes the ability to observe, to classify, to predict, to conclude, to communicate, to use tools, to measure, and to apply the concepts, and 3) possess attitude towards science that includes the senses of responsibility, discipline, perseverance, honesty, curiosity, and being open to the others' opinions. Those scientific capabilities can be grown up using appropriate scientific topics, particularly taken from daily life. These include topics about earth (water, air, metals, land, rocks, mountains, plants, animals), universe (stars, sun, planets, weather or seasons, energy, motion, chemical reactions), and the relationship between living things and the environment [11].

Meanwhile, science learning must be useful to stimulate the enhancement of children's thinking process ability, to develop scientific concepts, to produce scientific products, and to generate attitude towards science. The thinking process ability includes the children's ability to observe, to predict, and to

classify. The ability to develop scientific concepts includes the ability to provide names and labels, to make differentiations, and to define conditions. The ability to produce scientific products includes the ability to categorize and characterize things and materials, while the generation of scientific attitudes includes the possession of critical thinking skills, curiosity, and acknowledgement of scientific truths [12].

Science learning, above all, should be beneficial in developing children's rational ability. This includes the ability to think critically what to do or what to believe. Having the critical thinking ability, early-year children can build logical decision skills and are able to consider various points of view. Children who think critically can see and ask about things that they do not know, provide constructive comments and are able to find differences and similarities between the phenomena. The tendency to think critically of early-year children has existed when they curiously look at various objects around them [13]. This is why introducing science concepts in early childhood is becoming more important.

Introducing science to the early-year children, however, needs a prior step of identifying the nature of their recognition towards the scientific phenomena. This aims to understand to what extent the early-year children are aware of the existence of scientific phenomena, particularly in their daily lives. This understanding is important for PAUD teachers to choose what kind of learning activities that may engage those early-year children to actively talk about what they know. One of the teaching strategies that can be used to encourage children to talk is the question and answer (Q&A) activity. This learning strategy – as pre-mentioned above – had been used in this study to promote the children's engagement in talking about scientific phenomena pre-existing in their lives.

1.1. Purpose of the Study

Based on the above descriptions, this article aimed to investigate the enhancement of the early-year children's engagement in a science class in a PAUD in Jambi city Indonesia. This article was also written on purpose to uncover some scientific phenomena recognized by the children that are naturally pre-existed in their daily lives. The finding will provide important information for teachers in the PAUD about how to promote early-year children's engagement in a science class. The finding will also serve important information for teachers that the early-year children had been aware about science facts or phenomena that they discover in their lives that yet need to be further developed.

2. RESEARCH METHODS

2.1. Research Design, Time, and Participant

This study was carried out in early 2020 in a PAUD program in Jambi city, Indonesia. A group case study design was used in this study as this study aimed to understand the learning process that occurred in the class during meetings without any intention to see effects from various treatments [14]. In this study, the design was used on purpose to see the early-year children's engagement in some meetings and their recognition of scientific phenomena present in their daily lives. As of this, one class consisted of 15 children aged 4-6 year were involved in this study. One teacher was also involved in this study to run the lessons. The teacher -Yanti (pseudonym)- was a female, aged above 30, a bachelor in the area of Early-year Childhood Education, and had spent more than 20 years in teaching in the PAUD program. The involvement and exposure of the children and the teacher were then verified by the consent form issued by the authorities.

2.2. Lesson Plan

This study was conducted in four meetings. At the first meeting, the children were involved in the Q&A activity talking about the topic of food. At the second meeting the children talked about the topic of environment, at the third meeting the children talked about the topic of images, and at the fourth meeting the children talked about the topic of vehicles. The steps of the lesson in each meeting are as follows:

1. Opening; the teacher gave a greeting, checked the child's presence, and read a prayer.
2. Aperception; the teacher involved the children in a dialogue to remind the children about the previously discussed topic.
3. Topic delivery; the teacher told a narration about a topic-to-learn followed by a Q&A activity, invited the children to posed answers and questions, invited the children to express their life experience, and gave reinforcements to the children.
4. Assignments; the teacher distributed some blank papers for the children to write or draw something that they were interested in and relevant to the topic.
5. Closing; the teacher collected the papers and provided the conclusions of the day.

2.3. Data Collection and Instruments

During the study, data were collected using two instruments. A classroom observation protocol consisted of the observed and unobserved behaviors was used to collect data about the engagements of the children during the lessons (Table 1). Two observers were involved to collect the data in four aspects that included the children's paid attention listening to the teacher, readiness to answer questions, readiness to pose questions, and readiness to express personal interest. Meanwhile, data in the form of classroom

dialogue during the Q&A activities were collected naturally during the lessons using informal dialogue. The dialogues were recorded using a voice recorder to collect data about the natural scientific phenomena recognized by the children.

2.4. Data Analysis

The observational data were analyzed quantitatively to see the number of children who had participated in the four learning aspects in each meeting. The validity of the data analysis was achieved by triangulating the results of the observations collected by the two observers. This is called the technique of data-resource triangulation. Once the data from the two observers had reached a high similarity, then the data were considered valid. To increase the trustworthiness of the data analysis, a peer-discussion technique was carried out involving the researchers to draw agreement [14].

Meanwhile, the dialogue data were analyzed using a basic descriptive qualitative method [15] to see the recognition of the children about some scientific phenomena. The process included the transcription making, data reduction, and coding to get themes of the phenomenon. The validity of the interview data analysis was achieved by applying the member-checking technique involving the teacher to justify the results of the interview. Similarly, the trustworthiness of the data analysis was increased by applying a peer-discussion technique involving the researchers to draw agreement.

3. FINDINGS AND DISCUSSIONS

3.1. Findings

3.1.1. The children's engagement during the lessons

The results of the observations showed that there were increased engagements of the children from the first to the fourth meeting. The increased engagements were represented by the increased number of children who were observed taking part in the four aspects of learning. These included the aspects of paying attention and listening to the teacher, readiness to answer questions, readiness to pose questions, and readiness to express personal interest (Table 1 and Figure 1).

Table 1. Children's Engagement During the Meetings

No	Aspects Observed	Criteria	Meetings/ Number of Student (n = 15)			
			1	2	3	4
1	Attention to the teacher	Observed Unobserved	8 7	10 5	13 2	15 0
2	Readiness to reply	Observed Unobserved	5 10	6 9	8 7	10 5
3	Readiness to pose questions	Observed Unobserved	1 14	2 13	5 10	7 8
4	Readiness to express interest	Observed Unobserved	0 15	0 15	1 14	3 12

Data in Table 1 and Figure 1 show at the first meeting there were 8 children who listened to the teacher and the remaining 7 children were busy with their own. At the next meetings, the number of children who paid attention to what the teacher was talking about increased to 10, 13, and 15. This enhancement was also observed in the other three aspects from the first meeting to the fourth meeting. The number of children who got involved in answering the teacher increased from 5, 6, 8, and 10, followed by the number of children who started to pose simple questions (1, 2, 5, 7), and the number of children who were willing to express their interest (0, 0, 1, 3).

3.1.2. The Scientific Phenomena Recognized by the children

In addition to the result of the observations, the results of the classroom dialogues showed that the children recognized six science phenomena. They recognized the phenomena of pointed objects, air and its pressure, water and its function, temperature, mirror and light, and wings and flying phenomenon. The descriptions of the lessons and the children's recognized scientific phenomena identified in the four meetings are presented below while the sampled dialogues are presented in Appendix 1.

3.1.2.1. Meeting 1: Pointed Objects and Air Pressure (The Topic of Foods)

At the first meeting, the teacher talked about food. The teacher talked about satay, the Indonesia street food which is made of meat and normally pierced on a pointed bamboo stick (skewer) before being grilled. During the teacher narrating about the satay, the teacher asked the children whether or not they know the object used to pierce the satay. The children responded that a bamboo stick is the object to pierce the satay before it is grilled. Then when the teacher asked why the skewer can be used to pierce the satay, the children simultaneously answered that it was because the skewer is pointed. Furthermore, during the Q&A activity, when the teacher asked the children about another example of pointed objects, the children replied that a pencil and a syringe are also pointed objects. All the children's answers showed that they had recognized pointed objects and their function to pierce other objects. A part of the dialogue is listed in Appendix 1.

Following the children's answer about the pointed objects, the teacher continued the Q&A about a balloon. The teacher asked the children what happened when a balloon is pierced using a pencil. Given this question, the children answered that the balloon would burst. Then, the teacher posed another question of why the balloon would burst, and the children replied because the balloon has air in it. Surprisingly, one child posed a question about why the burst balloon produced noise. The teacher replied that it was due to the abrupt and quick escape of the air from the balloon. These conversations inferred that the early-year children had been aware about the presence of air and its physical properties.

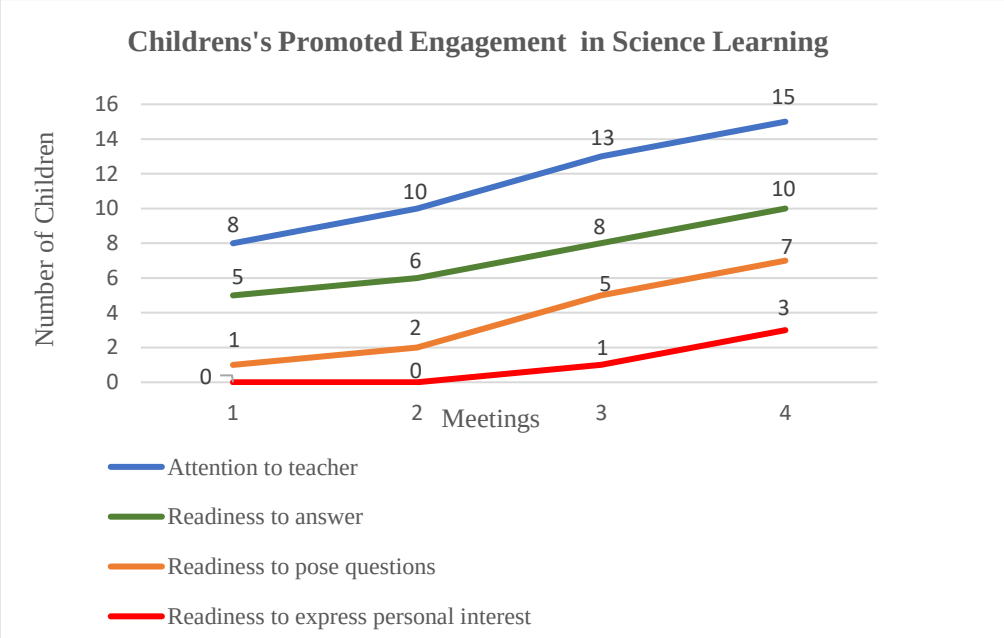

Figure 1. Early-year Children's Promoted Engagements in Four Meetings

3.1.2.2. Meeting 2: Water, Its Function and Temperature (The Topic of Environment)

At the second meeting, the teacher talked about the environment. During the teacher's narrating about the environment, the teacher also talked about water. When the teacher asked the children about water and its use for human in daily life, the children spontaneously answered with various answers that water can be used for drinking, bathing, brushing teeth, watering flowers, washing motorcycles, washing bicycles, washing cars, washing dishes, mopping houses, and for cooking. The children's answers were then elaborated by the teacher by asking other questions. The teacher asked the children what the purpose for a human is to drink some water, and the children answered to quench the thirst and to recharge their/her strength. The teacher also asked the children what the purpose for a human is to take a bath, then the children answered to keep the human's body healthy, clean and good smell. The children's answers showed that they already recognized water and its function for human life.

The children's answers about water and its use were further elaborated by the teacher by asking follow-up questions. When the teacher asked the children what the consequences if humans do not get water would be,

then the children diversely answered. The children answered that due to the lack of water, humans could be fainted, weaken, and even pass away. These children's answers emphasized that they had understood water and its vital functions for human life. Not only is the function of water as the material to meet daily needs, but also as the material for human consumption that guarantees human survival.

In addition to their recognition of water and its function, the children also recognized the nature of water which may have changes in its temperature. When the teacher asked what human used to make hot drinks such as coffee and tea, thus the children spontaneously answered hot water. The children's answers indicated that they already recognized the properties of water, particularly the temperature of water.

3.1.2.3. Meeting 3: Mirror and Lights (The Topic of Images)

At the third meeting, the teacher talked about images. During the teacher narrating the images, the teacher showed a mirror and said that the face of a child can be seen in the mirror. Then when the teacher asked about why the face of the child can be seen in a mirror, then spontaneously the children answered because the mirror was shining [there was light]. The children's answers showed that they had already recognized mirror, light and the function of light as the cause of the mirror to reflect the object in it.

The children's recognition of the mirror and light was then elaborated by the teacher by asking the children to go to a low-light room. Then the teacher asked the children whether or not the mirror can still reflect the image. Seeing that reality, the children spontaneously answered that the mirror cannot reflect the image. The object which was in front of the mirror cannot be seen in the mirror. The children's answers confirmed that they had recognized the function of the light as the cause of the object's image to be visible in the mirror.

3.1.2.4. Meeting 4: Wings and Flying Phenomenon (The Topic of Vehicles)

At the fourth meeting, the teacher talked about vehicles. The teacher asked the children about the type of vehicles the children might have got on board to go somewhere. The children mentioned some vehicles such as cars, motorbikes, buses, and airplanes. Then, the teacher further asked the children which one of the vehicles can fly. The children answered that it is an airplane. Finally, the teacher asked for the reason why an airplane can fly, and the children answered it is because of its wings. The children's answers indicated that they had already recognized the wings of the airplane and their functions.

In addition, the teacher elaborated the discussion by asking about other objects that can fly. The children answered bats, birds and butterflies. The teacher further sought for reasons why those animals can fly, and the children answered because those animals have wings. The teacher also asked them whether or not those animals' wings are the same as the airplane's wings. The children answered that the wings are different but can make birds and planes fly. These children's answers confirmed that they had recognized the function of wings as the cause of the flying phenomenon to occur both on the plane and those winged-animals.

Surprisingly, there was a child who expressed his experience watching a cartoon movie about a unicorn. He said that besides birds and butterflies, a horse can also fly. Given the child's expressed interest, the teacher gave appreciation for his expression. Then, the teacher further continued the elaboration about the flying horse. The teacher asked the class whether or not a horse also has wings, so that it can fly. Spontaneously, most of the children answered that a horse does not have wings. Then the teacher sought confirmation whether a horse can fly, and all the children answered that a horse cannot fly. Finally, the teacher reinforced that horses cannot fly as they do not have wings. This dialogue asserted that the early-year children had already had awareness and recognition about wings and their function in causing the flying phenomenon occurred on a plane and winged-animals. The sampled dialogue between the teacher and the children can be seen in the Appendix 1.

3.2. Discussion

The first purpose of this article is to understand the engagement of the early-year children in a PAUD class in Jambi city Indonesia as well as to investigate the enhancement that might have occurred during meetings. Based on the results of the analysis, it was seen that the early-year children had actively participated during the lessons. They demonstrated promoted engagement from the first to the fourth meeting. They paid better attention to the teacher, were getting readier to answer the teachers' questions, were getting readier to pose questions to the teachers, even they were getting more willing to express their personal scientific interest. The children's engagement and participation might come from the use of the Q&A activities which had been effective in stimulating the children to be involved in the lessons. This finding was

parallel with the results of a study conducted by Munasih and Nurjaman [9] that the use of Q&A activities improved the ability-to-speak of early-year children aged 4-5 years in their study in a PAUD in Tangerang city, Indonesia. They found that the ability-to-speak of the children –particularly the ability to express opinions – developed from 68% at the beginning of the study to 95% after the study using the Q&A. They argued that the enhancement of the early-year children's ability was caused by the effectiveness of the Q&A activities in attracting the children's attention to speak, to stimulate them to rehearse their thinking-process ability and to develop their courage and skills in answering questions and expressing opinions. In addition, according to a study conducted by [16], the use of Q&A activities integrated with science experiments had affected the development of the motivation and enthusiasm of early-year children in Banyuwangi city Indonesia to learn science compared to those in the control group (p-value < .05) who studied using a demonstration method.

The second purpose of this article is to identify some scientific phenomena recognized by children that are naturally pre-existed in their daily lives. Based on the results of the analysis, it was seen that the early-year children had recognized six different scientific phenomena that included the pointed-things phenomenon, the air, the water and its daily use, the temperature, the mirror and image, and the phenomenon of wings and flying. The early-year children had been aware about the presence of those simple phenomena of science even though they had not been taught formally by the teacher. Kambouri-Danos et all, [17] reckoned that daily activities of children could help them to easily learn science even before they enter PAUD, and these science knowledges may be developed during the school time. Some appropriate teaching methods may include Inquiry-based learning [18], demonstration [19], experiment [20].

The scientific phenomena recognized by the children can be called the naturally-built science knowledge of the children. Those kinds of science knowledge were normally built naturally in children's daily life as a result of their experiences and interactions with parents, peers, and any other resources such as the Internet, news, media, etc. These findings supported the result of a study conducted by Ratnasari [21] which showed that early-year children aged 4-5 years at one PAUD in Yogyakarta city had already acquired natural knowledge of science. She further developed the children's knowledge through the use of appropriate science experiments. She found that the children's knowledge particularly about the concept of air and its use in life increased after learning using simple science experiments.

Similar finding was also reported by Mustika and Nurwidaningsih [22] when they investigated the initial knowledge of early-year children about a color mixing process. They found that the children had already known about color and how to make the mixture of color. Such knowledge was further developed by inviting the children to do some experiments. The results indicated a significant difference of knowledge of the early-year children before and after the study. Then, Rohmah [23] also found that early-year children at Kediri city had possessed initial knowledge about the concept of sinking and floating before the beginning of their study. That initial knowledge was further enhanced by involving the children in some science experiments. She found that the early-year children's knowledge about the topic was developed from 66.66% (before the study) to 86.66% (after the study). She concluded that the experimental activities were effective in developing the children's knowledge about the concept of sinking and floating.

Based on the above discussions, it can be inferred that the engagement of the participant children in the science class was adequate and can be promoted through the use of Q & A method which involved them in using questions and answers talking about phenomena of science. Using this method, the children had been stimulated to be actively engaged in the classroom dialogue that in turn will increase their enthusiasm for learning science. Roestiyah [24] reckoned that the Q&A is a teaching technique to provide reinforcement for children/students in order for them to build their ability to ask and answers, particularly about the subject of science.

4. CONCLUSION AND IMPLICATIONS

This study had been successful in engaging the early-year children to be more active in the science learning activities. They became more focused on the teacher, readier to answer, readier to pose questions, and readier to express their personal interest in science. This study had also been successful in uncovering simple science knowledge possessed by early-year children. The children had recognized six phenomena of science which they identified as having existed in their daily life. These included the phenomena of pointed-things, air, water and its daily use, temperature, mirror and image, and wings and flying. The revelation of those naturally-built science knowledges of the children was affected by the use of the Q&A activities

the teacher used during the lessons. In that way, the children were initiated to express what they knew as they were stimulated to talk about those phenomena. It can be concluded that the Q&A activities had been beneficial in engaging the children to discuss their naturally-built science knowledge.

Some limitations, however, were observed in this study. Due to the rigid curriculum of the PAUD and the time limitation, the teachers were likely bonded to the curriculum and were more focused on achieving the curricular purposes which put them in a minimal freedom to design and construct scientific questions with a larger scope of science topics. Further study needs to overcome this issue to increase the quality of the questions by providing the teachers more freedom to do so.

AUTHORS' CONTRIBUTIONS

Author 1: contribute to primary and secondary data and analysis theory

Author 2: contribute to data processing and manuscripts

Author 3: contribute to analysis theory

Author 4: contribute to data processing and manuscripts

REFFERENCE

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