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WHEN SCIENCE BECOMES AN APPROACH IN EARLY LEARNING: KNOW IT, UNDERSTAND IT AND DO IT!

*[1]Qonita, [1]Ernawulan Syaodih, & [2]Edi Hendri Mulyana

[1]Sekolah Pascasajana, Universitas Pendidikan Indonesia
Jl. Dr. Setiabudi No.229, Bandung 40154, Indonesia
[2]Universitas Pendidikan Indonesia Kampus Tasikmala
Jl. Dadaha No.18, Tasikmalaya 46124, Indonesia
*Corresponding author: qonita1993@student.upi.edu

ABSTRACT

This review paper aims to explain and reinforce the view of how to teach science in early childhood education. Cuurrently, the need and interest of the community towards science are quite high. Science provides many contributions to various aspects of life including aspects of child development. Essentially, science is the process of discovering new knowledge through empirical experience. Science learning for children begins when the child shows interest and curiosity to the world around them. Science can be used as an approach by involving three components that is content, process, and attitudes that are holistically packaged and integrated into a series of learning processes and daily life of children because science can be done almost in all activities. However, educators still understand science partially, they regard science as a branch of science that only focuses on mastering the concept of theory, whereas science includes how to work, to think, and to solve problems. Through a learning approach developed from a science process approach, children are encouraged to actively observe, question, collect information, reason, and communicate their new knowledge. Although this approach is based on constructivism, educators still have an important role in supporting learning by having sufficient science ability.

Keywords: Early childhood, Indonesia, science, 21st century education, pedagogy

1.0 INTRODUCTION

21st-century education is characterized by increased awareness and public interest in science education (Broström, 2015; Spektor-Levy, Baruch, & Mevarech, 2013). This is because along with such a dynamic development of the current era many scientific discoveries that change the pattern of community life are made (European Commission, 2015). In addition, in the field of education and individual development, many research results show that science gives many positive effects on the development of individual's potential in various aspects including in cross-fields development such as math, social, and language (Conezio & French, 2002; Eshach & Fried , 2005; National Science Teacher Association, 2014; Trundle, 2010).

Since science contributes to many aspects of development, many experts recommend science to be introduced early (Eshach & Fried, 2005; Trundle, 2010). Children are considered capable of learning science because the nature of the children themselves is full of curiosity about their world and they always actively inquire and explore all new things around them (Conezio & French, 2002; Eshach, 2006; Martin, Jean-Sigur, & Schmidt, 2005; Spektor-Levy et al., 2013; Trundle, 2010). Early development of science competencies provides a strong foundation for the academic abilities, skills, and attitudes of children in the field of science and other fields in the future. Academic development is associated with the ability to understand concepts, developing skills related to the ability of children to solve problems in scientific ways, and developing attitudes related to analytical and critical attitudes in processing information. Other than that the development of science from an early age will give positive attitudes to science or other fields so that it will generate motivation and love of children to learn things in the future (Andersson & Gullberg, 2014; Gerde, Schachter, & Wasik, 2013; Spektor-Levy et al., 2013; Trundle, 2010).

However, there are still many misconceptions of teachers, especially among the teachers of Early Childhood Education in considering science. Teachers still teach science with traditional teaching method which they learned from the college. Whereas, science is not only a collection of difficult concepts to be taught (Conezio & French, 2002; Gerde et al., 2013; Maier, Greenfield, & Bulotsky-Shearer, 2013; Martin et al., 2005). Even when a child does an experiment, the child is not led to understand the purpose of the experiment, but only to follow the steps of the experiment. This causes the child's curiosity to finally disappear (Eshach, 2006). Science is not only knowledge but also attitude and skill (Conezio & French, 2002). Children should be continually stimulated to develop their curiosity (Trundle, 2015) through asking or expressing their ideas about something. Children are directed to be able to make the discovery of knowledge by themselves. It is children who have to make decisions, not teachers (Martin et al., 2005; Simsar, 2013).

In some countries, including Indonesia, the application of science as a learning approach has been implemented through the latest national curriculum established in 2014 as an innovation to pursue the challenges of modern life today. The learning approach is known as a scientific approach designed to enable learners to actively observe, question, gather information, reason, and communicate (Hosnan, 2014; Kementrian Pendidikan dan Kebudayaan, 2015). Based on the Indonesian Government Regulation (Peraturan Pemerintah) No.32 of 2013, the scientific approach is applied in all levels of education including at the level of early childhood education.

Undang-Undang (Indonesian Law) No. 20 of 2003 states that early childhood education serves to develop the potential of children and prepare children to be able to learn at the next level. It is believed that equipping children with the right skills and knowledge will shape the children into good and productive people. Integrated science activities in learning can provide a meaningful experience for the children. Experience helps children learn basic cognitive and social skills. Children can use these skills in their daily lives as a foundation for future learning and build their future (Simsar, 2013). Early childhood education, which in this case in the the form of schools, is a place where children are given the opportunity to perform some activities, such as trying and doing everything to meet their needs of curiosity through the proper guidance and direction of their teachers (Andersson & Gullberg, 2014; Broström, 2015; Trundle, 2015). Children are not scientists. However, through science in early childhood education their scientist potentials can be developed. Thus, teachers must have proper understanding and rich mastery of science to be able to teach them properly.

2.0 LITERATURE REVIEW

2.1 What is science?

Science is interpreted in different perspectives. According to Dewey, science is the result of observation, reflection, and testing (Eshach, 2006). Science is divided into natural science that studies the natural phenomena, and social science that studies about social phenomena. Nowadays, the conception of science is only considered as natural science which refers to facts and formulas (Conezio & French, 2002). This leads to another misconception towards science which is considered as scary and difficult. Eshach (2006) explains that science can also be viewed in two domains that is general knowledge domain and specific knowledge domain. The domain of general knowledge is not limited by a particular branch of science, but a systematic process for gaining knowledge. While the special domain emphasizes the content of knowledge of certain branches of knowledge.

More broadly, science is not only defined as theory and fact, but also includes ways of thinking, ways of working, and how to solve problems classified into three domains, namely content, process, and interrelated attitudes (Conezio & French, 2002). The content is in the form of knowledge, facts, and concepts. Such knowledge must be obtained on the basis of evidence. It is due to the distinctiveness of science is the existence of a correlation between facts and evidence (Eshach & Fried, 2005). The evidence is obtained through a process involving the senses, and the systematic stages of the process of science. The process requires careful attitudes to obtain accurate data, and then when an individual is used to gain knowledge through the process of science, he or she will have positive attitudes (Maier et al., 2013).

Nonetheless, science for young children basically emphasizes on the active process for finding new knowledge to know and understand the world around them. They are not required to understand complex concepts of science or science facts, nor are they required to carry out a systematic and rigorous science process (Conezio & French, 2002).

2.2 Why is science important in early childhood?

Essentially, human beings have curiosity and never stop asking. This trait has emerged since childhood when children have been able to start interacting with their world (Conezio & French, 2002). In addition, children have been burdened with very heavy learning tasks since they were born. Children begin to actively learn to master the new things about people or their environment (Conezio & French, 2002; Aamodt & Wang, 2002; Spektor-Levy et al., 2013). Young children naturally have the capacity to observe and explore the world around them which is a basic skill for learning science that can and should be encouraged and supported in the early years of their lives (National Science Teacher Association, 2014; Trundle, 2010).

Many adults, including educators, tend to underestimate the capacity of children to learn the ideas and practice science and fail to provide them with the opportunity to develop science skills and develop conceptual understanding (National Sience Teacher Association, 2014, Trundle, 2010). One of the causes is because previously science learning is influenced by the view of Vygotsky and Piaget which states that the conceptual skill of children is perceptual and not abstract in which the children interpret something based on the experience of the five senses (Gelman & Brenneman, 2004; Hamlin & Wisneski, 2012; Spektor-Levy et al., 2013). Children are considered not used to learn something before entering a certain stage of development. It

results in a view that science can not be taught in early childhood because they have not been able to conceptualize ideas beyond their developmental stage (Akerson et al., 2011; Jirout & Zimmerman, 2015).

Generally, there is no stand-alone concept without its relation to the background knowledge. According to Piaget, higher cognitive functions are revealed along with the development. In other words, as children grow, their ability to learn grows as well (Gelman & Brenneman, 2004; Roth, Goulart, & Plakitsi, 2013). Nevertheless, many studies had found that young children have cognitive abilities that enable them to study science (Eshach, 2006; Gelman & Brenneman, 2004; Roth et al., 2013). Young children are capable of developing a wide range of knowledge content about science, although the degree varies depending on how science is presented accurately to the extent of their development (Gerde et al., 2013). Although children still think intuitively and do not know yet whether it is true or not, as time goes by they will start to think scientifically with some assistance. In other words, they will start to answer or state something based on what they think and feel. Thus, a scientific truth for children is not absolute rather relative based on the experience gained (Hamlin & Wisneski, 2012; Trundle, 2010). For instance, when children do simple experiment of making a cup of tea, some of them may pour hot water instead of the tea first, while the others do contrary.

Research results show that most people believe that science education should begin in childhood. It is because first years of life are very important for the final result later. Young children have an innate desire to learn something which can be supported or undermined by the initial experience. High-quality early childhood education can enhance intellectual, linguistic, physical, social and emotional development, create school readiness and build the foundation for academic and social competence in the future (Spektor-Levy et al., 2013). Students must learn science because through science they learn about their world and everything around them. Moreover, children who learn science can practice their sensory abilities (Eshach & Fried, 2005). The accumulation of these findings has led to the development of approaches and programs for early science education (Spektor-Levy et al., 2013)

2.3 How is science taught to young children?

Since the early 1970s, it has emerged widely throughout the world, a strong interest in research on content-based learning and context in science (Gilbert & Watts, 1983). Especially, some findings state that almost every children in many environments "do science" almost all the time; they experience the world around them and develop theories about how the world works (Conezio & French, 2002). Although the children are indeed different from adults who have the knowledge and experience in conceptualizing the ideas of science, but children actually have the ability to understand and have good experience in science if they are supported by teachers (Akerson et al., 2011). Science is not only a dissemination of facts but also a process of acquiring knowledge (Gerde et al., 2013). Science is not just about the theme and content that should be taught in early childhood education but also the skills, attitudes, and values toward science that must be developed in early childhood (Spektor-Levy et al., 2013).

Fundamentally, science for young children is not much different from science for adults that is a knowledge discovery through an active process (Conezio & French, 2002). For children, science is all the process of discovery of something or phenomenon in their everyday world based on the experience of sensing to produce new knowledge (Conezio & French, 2002). The most important thing in learning science for young children is sensory optimization and it is done in play activities. There are many activities and opportunities for children to

sense something through the play activities. Play provides abundant opportunities for children to learn the concept of science (Hamlin & Wisneski, 2012). Science for young children can be conducted through planned or spontaneous activities whether in formal or informal situations (Broström, 2015; National Science Teacher Association, 2014). The formal situation is provided in the usual classroom with planned implementation through curriculum integration. The designed curriculum includes activities and instructions which are aimed at developing science skills for young children by integrating learning and other skills development areas, such as high thinking, language, and mathematics (Gerde et al., 2013; Jirout & Zimmerman, 2015).

Informal learning is spontaneously carried out both in the classroom and in the daily life of children based on the appearance of the children's interest about something. Long term informal learning activities can benefit children's formal learning (Broström, 2015). Teachers consistently stimulate interest and curiosity of the children by presenting various problems every day. The problems raised are not intended to provide exercises that test the children's abilities, but rather to do the learning that encourages the investigative skills of the children (Eshach, 2006). The goal of science for young children is not only to understand the concept, but also to develop childrens' interest and potential regarding their curiosity towards everything. It also teaches them how to do science through the use of scientific process in discovery activities (Broström, 2015; Martin et al., 2005; Jirout & Zimmerman, 2015). Thus, it can be concluded that science is not only an activity rather an approach to conduct investigation activities. This approach involves inquiry process, investigative hands-on activity, and discussion (Conezio & French, 2002).

The process of science is a scientific method that is a process of asking and answering questions by using a set of procedures such as observing, asking questions, predicting, experimenting, and discussing their findings. The scientific method used for children usually focuses only on simple process skills (Jirout & Zimmerman, 2015). In Indonesia, the development of a scientific approach focuses on five core activities, namely, observing, questioning, experimenting, reasoning and communicating.

2.3.1 Observing

Children naturally love to observe and think about nature, children are motivated to explore the world around them using all their senses (sight, hearing, smell, touch, and taste) to recognize an object observed (Martin et al., 2005). The more senses used in the process of observing the more information received and processed in their brain (Trundle, 2010). Observing is the main thing done in the scientific process to know what we want to find out.

2.3.2 Questioning

Curiosity which comes from observation process can lead to the questioning process. Questioning is a thinking process that is driven by children's interest about an object or event. Questioning is an important aspect of the scientific process because, in terms of understanding the nature of science, it is important for students to realize that they are looking for information that will answer questions they do not yet know the answer to (Jirout & Zimmerman, 2015). In essence, children like to ask questions. Children will keep asking until their curiosity is satisfied. Parents and teachers often kill children curiosity by assuming them as nosey children.

2.3.3 Gathering information

Gathering information is the process of seeking answers from various sources or various ways of asking the questions by children at the questioning stage. Teachers organize experiences that give children the opportunity to get as much information as possible. In order to gather information, children must collect relevant evidence. There is no right or wrong, but rather relevant to what is experienced or not. Science is the coordination between fact and evidence (Eshach & Fried, 2005).

2.3.4 Reasoning

The reasoning process for young children connects or matches the knowledge they already have with the new experience they gain. The reasoning process is related to the cognitive process suggested by Piaget (1977) which states that children obtain information through the scheme. When children manipulate objects in their environment, they will respond differently to different objects. The information is then assimilated with prior knowledge, resulting in new knowledge (Appel & Goldberg, 1977). In a reasoning activity, children's mind is still characterized by anthropocentric thought, they think the world is created by humans and humans are the center of the world. Many children hold an understanding of anthropomorphism while they associate human characteristics with non-humans, objects, phenomena or concepts. Children's thought is tied to the world as it is. Children only focus on the shape of the appearance shown (Broström, 2015). Teachers should try to understand children's perspective and try to correct the misconceptions experienced by them.

2.3.5 Communicating

Communicating is the process of sharing knowledge that is found. Communicating something can be done through spoken language, movement, and the results of the work (Gerde et al., 2013). Communicating affects the social and language skills of children. In communicating activities, teachers direct children to use appropriate vocabulary. Vocabulary is one tool for thinking, speaking, and working scientifically (Gelman & Brenneman, 2004). Such activities can provide a meaningful learning experience for children because at every step they use different skills to find new information. But the most important to implementation science process in early childhood education is through srtrengthening children's observing skill. Science without observing is not science, so the first step to teach science in early childhood is observing. Observing is a basic skill that everyone already has and that will take the children or person to mastery of other skills. Everything around children can be used as observation objects. Since children have short attention span and easily distracted by anything else, teachers have to provide clear and focused guidance on what they observe. The younger children, the more guidance they need; and vice versa.

Science education in Early Childhood is an integral activity of the normal class (Conezio & French, 2002). Hence, teachers have to design lesson plans which include science process, product and attitude through everyday activities which are not just confined to a scientific context in different areas of the classroom (Gerde et al., 2013). Teachers can choose the themes that relate to science as long as they reinforce the concept taught. They have to convey the exact concepts so that there is no misconception that will be carried by the children until they grow.

3.0 TEACHERS' ROLES IN TEACHING SCIENCE TO YOUNG CHILDREN

In science learning for young children, teachers play very important roles in the success of learning objectives (Spektor-Levy et al., 2013). Although science is based on constructivism and learning begins with children's curiosity, teachers are still responsible for directing, helping and encouraging children (Conezio & French, 2002). In guiding children, teachers do not directly transfer knowledge to the children, but instead, children gradually build the knowledge of science by themselves (Broström, 2015). Many factors influence early childhood teachers to support children's science learning. The main factor lies in the professionalism of teachers. Professionalism is not only about teachers' knowledge of science, but also includes teachers' attitudes and beliefs in science (Maier et al., 2013).

The importance of early childhood education teacher competence includes attitudes, the ability to understand children's perspectives and maintain and follow the interests and ways of thinking of children about the world around them. In understanding children's perceptive, teachers should regard the amazement of the statement the children present and become an active listener and show empathy in interacting with the children (Broström, 2015; National Science Teacher Association, 2014; Trundle, 2010). Furthermore, in the pedagogic content, teachers should plan an enjoyable learning environment through play activities. Integrating play and science in children daily learning activities can support the development of students' potential (Hamlin & Wisneski, 2012).

The first step in guiding children in science activities is to instill positive attitudes and beliefs about science by broadening the understanding of children's learning in science to explore how to help children in learning. Broaden understanding of the importance of science skills in life, and broaden understanding and skills in the development and teaching of science curriculum (Kirkwood, Bearlin, & Hardy, 1989). Chaillé and Britain (2003) list the teacher's role in schools of science learning as follows:

Teachers as presenters, present issues that inspire children to find out.

Teachers as observers, do observations related to the learning process of children, instead of observing the strength and weakness of children (Chittenden & Jones, 1998). Preschool teachers as passive but interesting observers who mentally and empathically support the experiments and construction of children's knowledge, but without intervention.

Teachers as stimulator, act as an example and a stimulous that encourages children to ask questions. Teachers as environmental managers provide and conduct a conducive environment for student learning process.

Teachers as collectors of children's learning documents, teachers evaluate children and learning through a collection of study documents to see the progress of learning. Teachers can document changes in children's understanding of scientific concepts while observing their activities (Hamlin & Wisneski, 2012).

Teachers as children's guide in building theory, even if children try to find knowledge themselves but they will have difficulty in building the right theory. Teachers help children to build their theory.

4.0 CONCLUSION

For children, their laboratory is the world around themselves and although scientific methods as the basis for investigating is needed, children may not pass through all the steps directly but gradually. However, the most important of science approach for children's learning is when children can find a new knowledge based on what they experience. Children should not only learn about science but through this approach children also learn about how to learn through science. Teachers need to play their roles efficiently so that pupils are interested to engage in science. Last but not least, ministry of education should train the teachers so that they can develop their teaching skills to be relevant for 21st century education.

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