THE IMPLEMENTATION OF *5E LEARNING CYCLE MODEL* ON THE TOPIC 'STRUCTURE AND FUNCTION OF PLANTS' TO IMPROVE THE SCIENTIFIC LITERACY OF THE SECOND YEAR STUDENTS OF A JUNIOR HIGH SCHOOL IN PEKANBARU

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Abstract: This study aims to improve student's science literacy skills by using *5E Learning Cycle model*. The treatment was conducted collaboratively for the topic 'Structures and functions of plants' involving Biology lectures, pre-service teachers, and the science school teachers of SMPN 21 Pekanbaru in August 2018. The focus of the observation was on science literacy and learning activities of students, both individually and in groups. Science literacy including scientific, procedural and epistemic knowledge was measured through worksheets. While the aspects of explaining scientific phenomena, evaluating and design scientific investigations, interpreting data, and the evidence were measured using an assessment sheet performance. Curiosity, scientific argumentation and environmental awareness were measured using the observation sheet. Learning activities carried out inside and outside the classroom had a positive impact on literacy skill science. The data showed the students individually or in groups could answer questions in the worksheet, more actively engaged, more enthusiastic and more curious when observing, identifying and grouping plants using real objects around school environment. Some questions arose from students when identifying corn and carrot plants about vegetative and generative structures. Overall, the implementation of *5E Learning Cycle model* can improve students' scientific literacy in learning science at SMPN 21 Pekanbaru.

Keywords: *5E Learning Cycle model, scientific literacy, junior high school*

INTRODUCTION

The twentieth century has been an undoubtedly a challenging era where the mastery of science and technology was the key elements for the development of a nation. For this reason, the science literacy is a basic need and compulsory for every citizen. To date, a country development is greatly affected by the quality of their human resources as indicated by literacy to science and technology (OECD, 2013). The OECD 2013 data and the PISA (Programme for International Student Assessment) data 2015 point out that

the science literacy score of Indonesian middle school students is 40, placing the 64th place of 72 countries. The low science literacy of Indonesian students indicates that the science teaching and learning in Indonesia has not been implemented as intended and therefore needs to be improved.

The Ministry of Education and Culture have made some significant changes in the education sectors, such as Curriculum 2013 (K13) and Gerakan Literasi Sekolah [School literacy program] 2015. K13 has been implemented through the scientific approach of five learning experiences namely: observing, inquiry, information gathering, rationalizing and communicating. Through these experiences, science students are expected to gain first-hand learning experience thus they can discover the concepts of learning holistically, meaningfully, authentically and actively (Benazir et al, 2017). However, the fact indicated the otherwise. Science learning was more dominated by content and facts that should be memorized by the students (Alok Irma et al, 2017).

Interviews with science teachers at SMPN 21 Pekanbaru provided some information that although K-13 and GLS have been implemented since 2016, there still have been some issues in the implementation. One of the biggest challenges was the learning design that could facilitate the students to be skillful in problem solving, evaluating and designing scientific research, drawing conclusion from the evident and applying the science into their real life. This fact was evident from the students' low proficiency in solving the problems related to the scientific phenomena in their life. For this purpose, an innovation on the science teaching is much needed, particularly at SMPN 21 Pekanbaru. In the beginning of academic year 2018/2019, a collaboration program was made in a form of teacher candidate placement and the supervision of classroom action research, between the Faculty of Teacher Training and Education, University of Riau and SMPN 21 Pekanbaru. This collaboration agreed upon an innovation to solve the challenge, one of which was the 5E Learning Cycle model.

5E Learning Cycle was firstly introduced by Robert Karplus in the Science Curriculum Improvement Study/SCIS (Trowbridge & Bybee in Made Wena, 2016). Learning Cycle was one of the learning models that apply constructivist approach. In this model, teacher role is to provide an environment where students can design and direct their learning more greatly. Instead of teaching the students directly and make them understand the material, this model promotes student active learning where they solve the problems independently, discover the solutions for themselves and working with ideas (Yatim Rianto, 2009).

5E Learning Cycle consists of five stages of Engagement, Exploration, Explanation, Elaboration, and Evaluation (Made Wena, 2016). Engagement stage aims to stimulate students' interest in learning, while exploration and exploration stages are intended to exercise students' procedural and epistemic knowledge. The elaboration and evaluation stages, on the other hand, promote students' ability to evaluate and design scientific

research, inferring conclusion based on the evident and applying the science in the real life situation. All phases in this 5E Learning Cycle are expected to improve students' science literacy. This current research is attempting to implement the 5E Learning Cycle model to the learning of 'Structure and Functions of Plants' at Class VIII.2 SMPN 21 Pekanbaru.

METHODOLOGY

This study was collaboratively conducted among Biology lectures, pre-service teachers, and the science school teachers at class VIII.2 of SMPN 21 Pekanbaru with a total number students of 41 during the academic year 2018/2019. The focus of observation was on the science literacy and student learning activities both individually and in group on the topic of lesson 'Structures and functions of plants'. The science literacy covers some aspects of scientific, procedural and epistemic knowledge. The mastery of science literacy was assessed through the worksheet. The skill aspects include: explaining scientific phenomena, evaluating and planning scientific research, interpreting scientific data and evidents. The aspects were recorded from students' worksheet. Students' attititudes such as curiosity, scientific argumentation and environmental awareness were assessed through observation sheets.

The implementation of 5E Learning Cycle was carried out in three main activities and five teaching steps. The initial stage is engagement where teachers stimulate students' interest and curiosity on the topic of learning by giving apperception and motivation. The main activities include exploration, explanation and elaboration. At the exploration stage, students observed some plants in the school area and discussed with their peers. At the explanation stage, students presented their discovery and understandings with their friends. Followed by elaboration stage, teachers gave some problems to the students to evaluate their mastery of concepts. Finally, at the evaluation stage, teachers gave a post test and asked the students to make summary of the lesson.

The data of learning outcomes that included science literacy, skills and scientific attititudes were then analyzed descriptively and categorized into: very good ($85 < N < 100$), good ($80 < N < 85$), poor ($67 < N < 75$) and very poor (<67).

RESULTS AND DISCUSSION

The learning activities carried out in this study consist of plan, do and see. The plan phase was conducted collaboratively on August 30, 2018 among Science teachers at SMPN 21 Pekanbaru, Biology lecturers from University of Riau, and university students on teaching placement at SMPN 21 Pekanbaru. The planning was accumulated as lesson design. Teaching instruments were reconstructed on the topic of 'Structure and fuctions

of plants" by developing a lesson design consisting the teaching and learning scenario, the step-by-step procedures and the timeline. This topic was divided into four cycles namely (1) body parts of dicotyl and monocotyl plants, (2) photosynthesis test (Sachs test), (3) plant tissue, (4) technologies inspired by plants. The lesson design for the first cycle was illustrated by Figure 1 below.

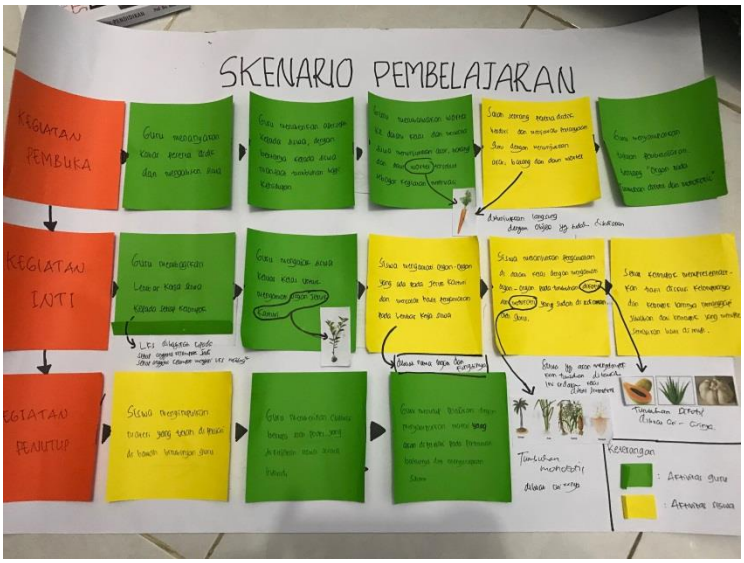

Figure 1. Lesson design on the topic "Body parts of dicotyl and monocotyl plants"

5E Learning Cycle model emphasizes on student active learning where teacher acts as the facilitator. There are five stages of 5E Learning Cycle namely Engagement, Exploration, Explanation, Elaboration, and Evaluation.

The engagement phase was initiated by teacher giving apperception and motivation to the students. In the context of this research, the teacher had a carrot to the class and asked the students to identify the parts of carrot (e.g. root, stem and leaves). Many students raised their hands to answer the teacher question, and the teacher picked one student while also asking other students to add or clarify their friend's response. This activity was intended to stimulate students' curiosity in science as shown by Figure 2. It can be seen that students seemed so enthusiastic in the topic of dicotyl and monocotyl plants.

Figure 2. Engagement phase

At the exploration phase, students were directed to learn outside the class to observe the parts of orange trees (Kasturi oranges) growing on school area. Teachers also provide other types of plants that were observed inside the classroom. The focus of this activity is classifying the plants into dicotyl and monocotyl groups, thus the exploration aims at developing students' research skills as parts of science literacy. In this stage, students explore their understanding and discuss with their peer groups. As students discuss and exchange ideas with others on the lesson, they were developing their procedural knowledge, scientific knowledge and also epistemic knowledge. Students were actively engaged in the learning activities shown by their participation in observation and cooperation with their group members. Students also posed some questions to their teacher on the discussed lesson. Teacher's role in this stage was to lead the discussion as shown by Figure 3 below.

Figure 3. Exploration activity in and out of classroom

Some questions students asked to the teacher:
Student 1 : Mam, why does corn have hair like soft thread?
Teacher : Who can answer the question of why do corns have soft thread hair?
Student 2 : Me, Mam! Hair on corns is actually a female reproduction organ
Teacher : Correct! Corn hair indicated female reproductive organ which plays significant role during reproduction

The teaching and learning situation as shown by the picture portrayed that the teacher did not directly answer student's question. Instead, she gave an opportunity for other students to provide the answers. The mechanism where a teacher provides guidance or probing is called scaffolding. Jumaidin Budaeng et al (2017) illustrated scaffolding strategy through a lesson section called "Coba Pikirkan [Let's Think]" on the topic of Mobility System where students did independent exercises while teachers reduced the amount of helps in solving problems and questions. Budaeng's study claims that students were motivated and able to solve the problems with a better understanding. Similarly, Ni Made Ratnasari et al (2018) also concluded that scaffolding technique could improve students' learning motivation and concept mastery in a Chemistry lesson.

At the explanation phase, each group presented their discussion results on the classification of dicotyl and monocotyl plants while the other groups respond and pose some questions. This phase aims at exercising and developing students' ability in interpreting scientific data, evidents and phenomena. Overall, most groups have presented the results correctly, except one group that misclassified turmeric as dicotyl instead of monocotyl plant. This inaccuracy, however, has been annulled by another group who clarified that turmeric belongs to monocotyl group. As suggested by Nugraheni (2017), explanation phase enables the students to construct and elaborate their understanding and comprehension as well as receiving feedbacks from their peers and teachers.

The following stage was elaboration, where students were discovering new problems and connecting some learnt concepts to provide solutions for the problems. Students who went through this elaboration stage very well did not have any difficulty in identifying the determining factors of problems and could easily solve the problems. In this study, elaboration stage was demonstrated by activities of plant modification where students were asked to explain about the modification of roots and trunks along with their functions. This stage encouraged students' development of scientific knowledge.

At the last stage of learning activities, teachers conducted an evaluation and follow up to the students individually to look into the achievement of learning outcomes and students' comprehension of the materials of 'dicotyl and monocotyl plant organs'. A study by Safwatun Nida et al (2017) indicated that the average score of students whose teachers combined both 5E Learning Cycle and Mind Mapping (71.64) was higher than those with 5E Learning Cycle only (65.09). It implies that the 5E Learning Cycle would be more effective when it is combined with other innovative teaching models or strategies.

Some observations on teaching and learning activities suggested that the implementation of 5E Learning Cycle on the sub theme 'Organs of dicotyl and monocotyl plants' has improved the students' science literacy. Some aspects of science literacy such as curiosity, scientific knowledge, procedural knowledge, epistemic knowledge, planning scientific research, interpreting scientific data and results, and explaining scientific phenomena have been developed from each stage of 5E Learning Cycle. These findings are in line with the study results by Desi Nugraheni, et al (2017) which asserted that 5E Learning Cycle consisting of engagement, exploration, explanation, elaboration, and evaluation phases has positively correlated to the students' science literacy and learning outcome on the theme of 'Human Nervous System'. Nugraheni also posits that each phase of 5E Learning Cycle encourages students' ability on critical thinking, problem solving, communicating in written, knowledgable and interpersonal ways in science learning. It can also improving students' ability to memorize, understand, apply, and analyze in the cognitive learning outcomes.

A study by Alok Irma et al (2017) mentioned that the 5E Learning model could improve the percentage of students' science literacy as much as 11.5% on multidimensional category and by 53.8% on the conceptual/procedural category.

The 5E Learning Cycle learning model has encouraged the students to be more active during the lesson because the learning activities were student-centered. The 5E Learning Cycle learning model also enabled the students to better comprehend the materials being learnt. This was evident when students were asked to summarize what they had learnt during the day; students were able to provide conclusions about the learning materials. This ability to provide summary indicated that students comprehended and internalized the lesson well, supported by the fact that they themselves did the learning inquiry and active learning, without waiting for the teachers to explain.

CONCLUSION

The study concludes that the implementation of 5E Learning Cycle could improve students' science literacy, particularly on the discussion of Plant Structure at the 8.2 Class of SMPN 21 Pekanbaru. The aspects of science literacy that were significantly improving are curiosity, scientific knowledge, procedural knowledge, epistemic knowledge, planning scientific research, interpreting scientific data and results, and explaining scientific phenomena.

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