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? 64 Science Learning Cycle Method to Enhance the Conceptual Understanding and the Learning Independence on Physics Learning Dwi Sulisworo1, Novitasari Sutadi2 1Department of Physics Education, Universitas Ahmad Dahlan, Indonesia 2MTS Miftahul Qulub, Pamekasan, Jawa Timur, Indonesia Article Info Article history: Received January 15th, 2017 Revised February12th, 2017 Accepted February 15th, 2017 Keyword: Conceptual understanding Learning cycle Physics learning Science education Vocational education Corresponding Author: ABSTRACT There have been many studies related to the implementation of cooperative learning. However, there are still many problems in school related to the learning outcomes on science lesson, especially in physics. The aim of this study is to observe the application of science learning cycle (SLC) model on improving scientific literacy for secondary vocational schools at physics. Through this research, it will be known its influence of learning methods and contribution to the understanding of physics concepts and student independence learning. This research is

a quasi-experimental design with pretest and **posttest control group** which **the independent variable** 9

is learning the method and the dependent variable is the conceptual understanding. The result shows that there is an effect of teaching method on the dependent variable. It also shows that the conceptual understanding of the students in the treatment group who applied methods SLC is better than the control group.

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1. INTRODUCTION

Common to all science education reforms around the world is the **emphasis on achieving science literacy by all children before high school graduation**

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[1]-[2]. It is difficult to give the clear definition in term of scientific literacy especially when translating this term into another language than English [3]. Literacy in science will determine the progress of technology invention and innovation in the certain community [4]-[5]. By learning science, students can be better ability to think more critical and creative. The results of research in Europe associated with the level of student interest in learning science showed that there was a decline in student interest in learning physics rather than biology or chemistry study for a period of 15 years. While experts believe that learning physics is a good basis for understanding the biology and chemistry learning. There are fears the decline of interest will result in the declining of technology in the long term. The same result was found in many another country, that

students are failing to learn much that is useful in science, mathematics, and technology; therefore **curricula must emphasize depth of knowledge, not** the **breadth of information**

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[6]-[8]. Complaint on the difficulty to learn is always expressed by the students in any school. This complaint related to the classroom environment problem. Teachers' assessment practice has

been the focus of much attention for over the past years. However, significant interest in classroom assessment environment is a recent phenomenon [9]-[11]. **The**

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teacher has been attempting various strategies and learning media in schools to increase student motivation and interest in learning science [12]-[14]. It is caused by the awareness

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the importance of the science literacy for students. Science literacy can be

defined as an **ability to read and** to **use** the **written information and to write** well **in** science. This kind **of** literacy **is used to develop knowledge and understanding, to achieve** individual **growth and to** 2

have a positive role in the wider community. There have been many studies related to the implementation of cooperative learning in the school for the implementation of a competency-based curriculum [11]-[15]. However, there are still many problems in school related to the learning outcomes on science lesson, especially in physics for instant on the learning achievement, ability to work together or teamwork ability, and ability to be an independent learner [16]-[17]. From other studies, it showed that Science Learning Cycle as a learning strategy is effective to be used for those purposes [19]. Considering the learning problem and the opportunity of SLC, this study will observe the implementation of SLC to improve scientific literacy on the physics lesson in the secondary vocational school. This research will explore the influence of learning methods and its contribution to the understanding of concepts and the ability as an independent learner. The physics concept that is used in this study was Direct Current on Electricity at Vocational Higher School students grade 11. 2. THE ORETICAL BACKGROUND SLC is learning that use science literature including reflection journals, class notes, the inquiry data, and other artifacts of learning that reflect the stages of a scientific investigation. All of these will be represented through discussions between roles of the group [18]. The aim of SLC is to assist students in an understanding of big idea related to the concepts of science in a certain theme. SLC consists of three main interconnected components, which are organizing the science record, role on literacy cycles, and the artifacts that made by students. There are seven stages of investigation in SLC model [18], namely: a. Questions. Students formulate a problem. The forms of posed problems are questions regarding the learning material in the relevant theme. b. Prediction. Students are asked to formulate the predictions of the determined questions. Each role on the group formulates the prediction on his/ her perspective, and then these were documented by students who act as great idea developer. The Prediction is a forecasting or an estimation of the results of some experiments in the laboratory, or some observations of nature phenomena. c. Planning. Based on the predicted results, each role plans and determine an investigation procedure of some phenomena to find the answer. Then, they have to evaluate whether these predictions are accurate or not. d. Observation. The aim of this stage is to validate the predictions that found at the previous stage. This stage includes data collection, analysis, and evaluation of the data processing results. e. Conclusions. The result conclusions are still tentative because it only answers to prove the prediction of the original question. f. New questions or ideas. At this stage, the idea developers large and discussion leader determines the bigger idea of the group based on the results of tentative conclusions and the objective of the investigation. This stage is the follow-up process of the concept investigation allowing the creation of new findings of science concepts. g. Conclusion journal. This stage is to prepare the journal of conclusions and reports of the student activities. 3. RESEARCH METHOD This research is a

quasi-experimental design with pretest and **posttest control group. In** 7

both groups have been selected the homogeneous group on initial/previous knowledge. Then each group was treated using different learning strategy; where the treatment group will be applied with SLC method; and other will be applied with a conventional method. As a quasi-experimental design, it assumed that there were no effect of confounding variable by using the stratification on statistical analysis stage therefore

groups within which the confounder does not vary 16

[19

].Mediation and confounding are identical statistically and can be distinguished only on conceptual grounds 8

[20]. The homogenity test was applied to ensure that the both groups are not vary significantly before further statistical analysis using MANOVA. Only the dependent variables that affecting the dependent variable. The number of students is 30 students

and 32 students **for the** treatment **group and** control **group respectively.** 6

Then, the independent variable is Learning Method; and the dependent variables are students' understanding concepts and student ability as independence learner.

Table 1 shows the research design. Table 1. Research 14

Design GROUP PRETEST TREATMENT POSTTEST Experiment O X O Control O Y **O** 11

Learning instruments include a syllabus, lesson plan, and student worksheet. Syllabus refers to the national standard for secondary education in Indonesia, especially on Competence Standard and Basic Competence. While the lesson plan and worksheet instrument are tested its validity before used in research. Two teachers observed the implementation of the instrument during learning. Instruments to collect the data of the dependent variable are the conceptual understanding test and independent learning questionnaire. The items to measure the conceptual understanding are included the items of translation, interpretation, and extrapolation of the knowledge. The learning phases of this research, especially for the

treatment group, consist of: preparation on learning on certain physics concepts, giving an introduction and motivating the student related the SLC implementation, student learning on SLC stages (question, prediction, planning, observation, conclusion, new idea, writing journal), measuring the activity (conceptual understanding, students' independence learning). One of the techniques to determine the learning progress is comparing the gain of the pretest and posttest. Pretest related to previous or initial understanding. It measures the understanding of students about physics concepts before learning. The posttest measures the conceptual understanding after treatment or learning in certain strategy. The form of the question to measure the understanding is multiple-choice containing 25 problems that have been tested the validity, the level of difficulty, and the reliability. The increment of student learning is measured by the gain value. The gain value or N-gain is calculated using equation 1. G ? ??SSmpoasxt ? S pre ? ? S pre ? (1) Where: G: normalized gain index Spost: posttest score Spre: pretest score Smax: maximum/ ideal score The interpretation of the N-gains calculation is shown in Table 2. Table 2. Criteria of N-Gains Categories Value of G High 0.70 < G Moderate 0.30 ? G ? 0.70 Low G < 0.30 The instrument to measure the ability to be independence learner is used in order to determine the level of independence of student on learning. These characters can not be expressed with true or false but can be explained through the response according to the condition of each respondent. This instrument consists of 20 items and used Likert scale. The measured aspects in this variable are the independence of others, self- confidence, discipline, sense of responsibility, initiative, and self-control. The factors of this instrument are shown in Table 3. Tabel 3. Items of the Independence Learning Instrument No. Scoring Aspects Item No. 1. independence of others 1(-), 4(-), 6(+), 16 (+) 2. self-confidence 8(+), 10(-), 17(+) 3. Discipline 11(+), 12(-), 18(+) 4. the sense of responsibility 7(+), 13(-), 14(+) 5. Initiative 2(+), 3(+), 5(-), 20(+) 6. self-control 9(+), 15(-), 19(+) The alternative hypothesis is there is an effect or an influence of learning methods to the conceptual understanding and independent learning among students. The confidence level used 95% or 5% probability of error. 4. RESULTS AND ANALYSIS The following Table 4 is the result of pretest and posttest on the conceptual understanding of both groups. From this table, the gain value can be calculated. From Table 4, it can be known that the average score of the conceptual understanding at the posttest for experiment

group is higher than the average score **of the control group,** 7

ie 18.17 to 14.09 respectively. To determine the gain value, Table 5 is used. Table 4. Statistic Distribution of Pretest and Posttest on Conceptual Understanding No. Group No of Student Score Sum Mean Max Min Std. Deviation

Pre Post Pre Post Pre Post Pre Post Pre Post 1. 12

Exsperiment 30 295 545 9.83 18.17 18 25 4 12 3.86 3.39 2. Control 32 306 451 9.56 14.09 17 21 4 8 3.34 3.02 Table 5. Distribution of Gain Value on Conceptual Understanding No. Group Categories Sum Low Moderate High 1. Experiment 0 24 6 30 Control 2 . 16 16 0 32 Using equation 1, it can be calculated the gain index which it obtained an increase in experiment group 0.58. That is an increase in students' conceptual understanding affected by the implementation of SLC method. It is

in the medium category. But on the other hand, the gain for the control group is 0.29, which means it is in the low category. This suggests that an increased of conceptual understanding who learned SLC is better than who learned with the conventional method.The result for the ability to be the independent learner at the end of the teaching and learning process is shown in Table 6. Table 6. Distribution Score on Independent Learning Questionnaire No. Group No of student Score Sum Mean Max Min Std. Deviation 1. Experiment 30 2442 81.40 86 77 2.27 2. Control 32 2197 68.66 72 63 2.13 Descriptive analysis is used to determine the percentage of the level of students' independence for each group in order to obtain the number of students with certain independence learning level as

shown in Table 7. Table 7. Number of 15

student on Independence Learner Level Group Categories of Independence Learner Level Very high High Enough Low Very low Sum Experiment 1 26 3 (3.33%) (86.67%) (10%) - - Control - - 1 28 3 (3.13%) (87.50%) (9.38%) 30 (100%) 32 (100%) The results of the questionnaire analysis on learning independence show the average scores of students in the experiment group were 81.40 and the control group was 68.66. It means that the learning independence of student who used SLC method is better than the students who used the other model. Based on the calculation, the percentage of students with a categorical level of learning independence are 86.67% is a high learning independence who received SLC model, but 87.50% of students who received treatment lecture method were low. This showed that the SLC method can improve students' learning independence. The high autonomy of student learning in the classroom involves the SLC method can not be separated from the discussion activity of students during the learning process. The division of roles in learning SLC demanding the student's responsibility to obtain information from several sources to learn about the learning material, to be submitted to other members in order to produce a joint conclusion. The spirit of student independence in learning can be observed during the learning SLC lasts. This is shown by the active participation of students in asking, argue, communicating information, and concludes the discussion. It was also indicated by the sense of responsibility for good working in accordance their role, efficiency in the use of learning resources, as well as the discipline of time in collecting statements as a result of group activities.The statistical parametric analysis used in this research is MANOVA. The summary of this analysis is shown in Table 8. Table 8. Summary of the MANOVA at error level 5% Independent Variable Dependent Variable F Sig. level R2 Learning Method Conceptual understanding and Independence Learning 324.865 Conceptual understanding 24.983 Independence Learning 519.518 0.000 0.000 0.000 0.917 0.294 0.896 From the analysis, the value of F is 324.865 which is the error probability smaller than 5%. Thus the alternative hypothesis can be accepted. It means that there is the influence of learning methods to the conceptual understanding and students' independence learning simultaneously on the certain physics subject. Determination coefficient (R2) is 0.917 indicating the influence portion of learning method to the conceptual understanding and students' independence learning. In the other word, 91.7% both of conceptual understanding and students' independent learning are influenced by learning methods, while 8.3% are influenced by other variables. The separate analysis showed that the learning method has a significant influence on the conceptual understanding which the F value is 24.983 with an error level is less than 5%. Determination coefficient (R2) is 0.294 indicating that 29.4% of conceptual understanding was influenced by the learning method. While, 70.6% was influenced by

other variables, one of them is students' learning independence variable.The learning method variable also has a significant influence on students' independence learning. It was concluded by the value of F equal to 519.518 on error level less than 5%. The determination coefficient (R2) is 0.896 indicating that 89.6% of students' learning independence was affected by the learning method, while 10.4% is influenced by other variables. From this study, if the teacher gives space of opportunities for students to work in their ways and ideas, then they will be able to develop knowledge, understanding, or skill independently. This skill is very important in their daily application to solve real-world problems (Wahyono, 2013; Holstein, 1986). The opportunity provided by the teacher during the learning process using SLC can be observed from the activities during the group discussion. For example, the opportunity to plan an experiment, seek information either from the literature and the Internet, compile predictions, prepare simple electric circuit in accordance with the available tools and materials, draw conclusions, prepare the activity report, ask and argue on a discussion, and present the results of the discussion. The objective of these activities is to encourage and familiarize students to learn independently, as well as to improve students' understanding of the physics concept. Students are considered successful in learning if they have the capability to learn independently either through interactive media and literature sources. However, not all students have the same ability. For example, the ability to understand the concept of certain physics phenomena. Therefore, distributing roles/ tasks in SLC learning can be tailored to the capabilities of each member so they can exchange their information among group members.The result indicated that learning method significantly influences the conceptual understanding and the students' independence

learning. The application **of** SLC **learning** method **will help students to** 17

improve science literacy and develop their characters. Using this strategy, students become more active to carry out their assignments, as well as honest and more communicative on information sharing. In the implementation of SLC, the teacher will find the role of the literacy circles to provide new ways of thinking about every scientific concept. To be considered that the responsibilities of each role should be adjusted to the ability development of each student. This research support another result that SLC as one of the constructivist learning method has the potential to maximize the chances of students in the learning achievement about scientific concepts from either independently or social. In the overall SLC model integrates students in productive thinking to create a picture of the idea of science concept. This is the reason why conceptual understanding on physics and students' independent learning can be enhanced through SLC method 5. CONCLUSION From the results and discussion can be concluded that there is the significant effect of learning methods to the conceptual understanding and the students' independence learning. The contribution of the learning method to both variables is 91.7% simultaneously. The contribution of learning method to the conceptual understanding was 29.4% and 98.6% to students' independence learning. The student who applied SLC method has better improvement on their conceptual understanding and their independence learning either. ACKNOWLEDGEMENTS This research was supported by

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