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The Effectiveness of Learning Physics Based on Multi Representation Integrated with Guided Inquiry to Train Students' Science Literacy

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***Abstract*—Learning physics based on multi representation integrated guided inquiry is a learning with different ability of representations (graph making, data recording, formulating) through data gathering, data analyzing and answer finding to questions (guided inquiry). The purpose of this research is to analyze the effectiveness of learning physics based on multi representation integrated with guided inquiry to train student scientific literacy. This research was conducted in MAN 2 Kediri (public school) academic year of 2017/2018 involving 15 students of grade XII. This research used pretest-posttest one group design to find out students scientific literacy. The data revealed that learning physics based on multi representation with integrated guided inquiry is effective to train student scientific literacy and resulted in positive response from students which was indicated by the high result of the N-gain category. To sum up, it can be implied that learning physics based on multi representation with integrated guided inquiry is effective to train student scientific literacy.**

Keywords—Multirepresentation; Guided inquiry; Student scientific literacy

I. INTRODUCTION

The 21st century skills consists of four major domains, namely, literacy, inventive thinking, effective communication, and high productivity [1]. Among these, it is necessary to develop scientific literacy. According to the OECD, scientific literacy is the ability to use scientific knowledge to identify problems and draw conclusions based on the evidence in order to understand and make decisions about the nature and change [2]. Scientific literacy assessment that is used in the realm of competence includes aspect of explaining the phenomenon with scientific evidence, evaluating and designing scientific inquiry, interpreting data and evidence. The participation of Indonesia on Program for International Students Assessment (PISA) year 2012 and 2015 makes Indonesia ranked in the fifth position in education system from 75 countries [3]. Unfortunately, the results of the OECD PISA 2014 test conducted in MAN 2 Kediri proved that the ability of students towards scientific literacy is still low with a range of 20-30.

Scientific literacy was accommodated since Curriculum 2006 (KTSP) and then is defined in more detail in Curriculum 2013. In its application, the knowledge obtained in curriculum of competence based (KBK), curriculum unit (KTSP), and Curriculum 2013 contains the knowledge domain developed in PISA which contains the competencies of attitudes, knowledge and skills in an integrated manner. Mayer [4] states that inquiry is a learning approach that engages students to investigate, ask questions, create inventions and test the hypothesis to get new understanding.

In Learning physics of Curriculum 2013, students are required to master the different representations (experimentation, concepts, formulas, drawings and diagrams) [5]. Learning by involving multi representation provides a rich effect on students, because with the existence of multi representation students are expected to place the concept in verbal form, graphs, tables and also formulas. As Lemke [6] notes that in the process of developing science literacy students not only have to understands scientific phenomena and but also the concepts. Scientific literacy gives meaning the ability form a collective with a wide range of representation (multi representation) such as visual representation, mathematical relationships, manual or technical operations and verbal concepts [6]. Waldrip and prain [7] states that multi representation is the way to represent the same concept with different formats, including verbal forms, images, graphics and mathematics. Through the worksheet given by the teacher the student can represent the results of experiment in multi representation.

The purpose of this research is to know the ability of student scientific literacy through integrated with multi representation learning guided inquiry. The research design used in this study is one group pretest-posttest. The results show that students scientific literacy is improving after the

implementation of guided inquiry integrated with multi representation based learning process. This is because multi representation integrated with guided inquiry-based learning has syntaxes which can be combined with indicators of science literacy skill. From the results of research, it can be concluded that multi representation integrated with guided inquiry based learning can improve students of MAN 2 Kediri about scientific literacy.

II. METHOD

This research used one group pretest-posttest design. Implementation of the research was conducted in MAN 2 Kediri grade XII followed by 15 students academic year 2017/2018.

The variable in the study is student scientific literacy. Such a variable is measured using scientific literacy test containing 15 items adapted from the selected scientific literacy indicators. The indicators are selected using guided instruction syntax. These are explaining phenomenon with scientific ideas, designing and evaluating scientific research, and interpreting data and facts scientifically. Score assessment is made in the form of difficulty level of problem. Descriptions of the science literacy ability criteria used are complete and incomplete [8].

The ability of student scientific literacy can be measured by summing the scores obtained by the students and divided by the total score of all questions multiplied by 100%. Then it displays the extent to which student scientific literacy skills develop. To find out the capabilities of scientific literacy of students before and after treatment a descriptive quantitative data analysis is then conducted. Increased literacy skills of science and improvement of the completeness of indicators about science literacy can be obtained by summing the posttest score difference with the pretest score divided by the difference of the maximum score minus the pretest score [9].

III. RESULTS AND DISUCUSSION

The results obtained from this research is the ability of scientific literacy from 15 students with the percentage of students based on the criteria of science literacy ability before and after learning. As shown in Figure 1 that the N-gain calculation results show that all students experience an increase in scientific literacy. Six of the fifteen students, students with serial numbers 6,7,8,10,12, and 13 are categorized high in the score of scientific literacy, whereas the other 9 people experience increased science literacy category.

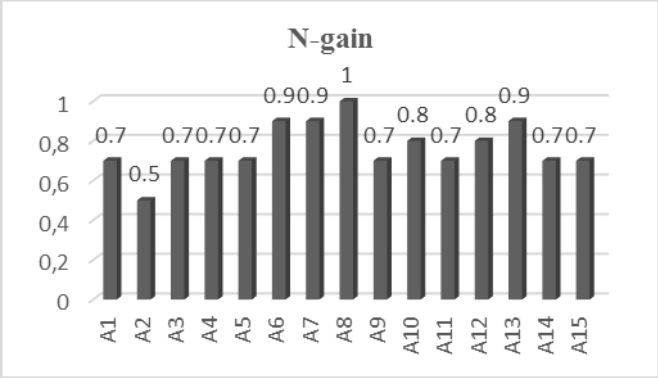

Figure 1: Science literacy test results (N-Gain)

Data from the analysis of pretest and posttest of 15 students obtained N-gain with an average of 0.8 to a high category. Improving the ability of scientific literacy of students is due to the lesson activities using learning-based multi representation integrated guided inquiry in which the syntaxes of guided inquiry are able to activate students in learning activities through the curiosity of phenomena or issues presented by asking questions. It then leads to the investigation for the conclusion of the concepts learned. As Vygotsky's theory states that students can work to understand concepts with the help of their friends [10]. Increased scientific literacy of students is also a reflection of the understanding built from high curiosity and motivation to learn, as proposed by Piaget that curiosity, their motivation to actively build their understanding of the environment in they live [11].

As for the pretest and posttest results of scientific literacy indicators can be seen in Figure 2. The results show an increase from pretest to posttest. The sensitivity of scientific literacy indicators increased n-gain ranged from 0.74 to 0.81 with medium to high category.

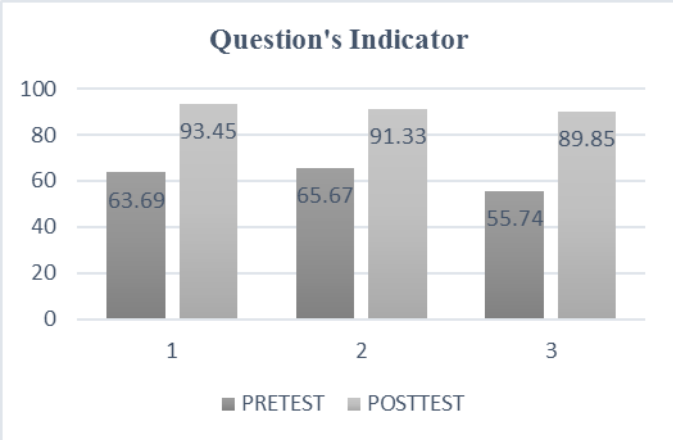

Figure 2: The Average Question's Indicator (N-Gain)

The indicators average graph is the result of knowing the sensitivity of the science literacy indicators, i.e. by calculating the sensitivity level of each item. It can be concluded that all the items developed have a sensitivity level above 0.30, thus it can be expressed sensitively [12]. The results of scientific literacy scores obtained during the pretest was extremely low, this is due to the lack of students abilities to solve problems that require reasoning scientific literacy, logical thinking, the reasons are accompanied by experiment, alternative solutions to solve problems, make decisions from a natural phenomenon in everyday life. While the results obtained at each indicator of posttest has increased n-gain high. Improving the ability of science literacy is due to the lesson activities using learning-based multi representation integrated guided inquiry which syntaxes guided inquiry is able to activate students in learning activities through the curiosity of phenomena or issues using questions that lead on the investigation for the conclusion of the concepts learned. Dewey stated that the use of experimental learning is more meaningful where students can find their own answers to the problems given [13]. This is consistent with research conducted by Fang & Wang (2010) indicating that inquiry learning can increase science literacy. Nisa (2016) also reveals in his research that guided inquiry can trace the science literacy.

IV. CONCLUSION

Learning physics in this research based on multi representation integrated with guided inquiry. In general, multi representation integrated with guided inquiry is effective to train students science literacy showed by N-gain score ranging from 0.74 to 0.81. Scientific literacy of students can be improved through syntax on based multi representation integrated guided inquiry in terms of 1) Planning 2) Retrieving 3) Processing 4) Creating 5) Sharing 6) Evaluating, according to Vygotsky's zone of proximal development theory.

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