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Can the guided inquiry with environment learning resources increase conceptual understanding and scientific literacy?

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Can the guided inquiry with environment learning resources increase conceptual understanding and scientific literacy?

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Abstract. This study was aimed to improve the quality of chemistry learning process, learning outcomes and scientific literacy in electrolyte and nonelectrolyte material by application of guided inquiry with environment learning resources. This classroom action research was conducted at tenth grade of class IPA 2 SMA Negeri 1 Banjarmasin by involving 35 students, a teacher and three observers. Scientific literacy and conceptual understanding data were collected using multiple choice test. Meanwhile, teacher and student activities data were collected using observation sheets. This classroom action had increased quality of teacher activity from moderate to good, students' activity from less active to active, students' scientific literacy from moderate to high and chemistry conceptual understanding from 51.42% to 91.42% of completeness level. It was concluded that the guided inquiry with environment learning resource was effective to increase quality of chemistry learning process, students' learning outcome and scientific literacy. To make the meaningful chemistry learning, it's importance to use environment learning resources which are close to the students.

1. Introduction

The purpose of science education is to prepare students in order to understand science concept and its implementation to solve the problem around them. It means that science education should focus on students' scientific literacy [1]. Unfortunately, how to learn scientific literacy has not been well understood yet by the Indonesian teachers. As a result, learning process has been still focused on the students' conceptual mastery [2] and has not been able to train the scientific literacy optimally [3]. For instance, students could not develope research questions as well as perform experiments well yet. Even if they performe the experiment, it just to verify theories, not to investigate the science problems. The OECD triennial reports reveal that Indonesian students' scientific literacy score was below the OECD average score [4] [5]. A total of 42.3% below level 2 of the scientific literacy in which they have a limited knowledge that can only be applied to some known parts. They can provide a clear and accurate explanation of the provided evidence. Only 0.8% of them were placed on level 5 or 6 and 56.8% were on the 2-4 level range. The low of students' scientific literacy indicated that we need to improve the quality of science learning.

Observation to the chemistry learning process conducted at SMA Negeri 1 Banjarmasin showed that students were still accustomed to receive all the information just from the teacher. They were not able to find out and process information about learning materials independently. They were not directly involved in connecting knowledge and ideas with the information they learn to find the new concepts. They have been faced difficulties in interpreting data independently, so they have been thickly depended on the teacher. Though, the ability to do scientific investigation as well as interpret the scientific data are very important parts of the scientific literacy competence. Consequently, they had not been able to achieve scientific literacy competence.

Scientific literacy was not only defined as the ability to read and understand science concepts but also the ability to understand and apply the principles of science in everyday life [6][7]. So, the promoting of laboratory activity, optimizing the use of learning resources close to their daily life as well as changing classroom learning strategies from teacher-centered to student-centered are the ways to increase scientific literacy. Students have to be accustomed to engage in science knowledge constructions actively to produce meaningful learning by using proper learning strategy as guided inquiry [8] [9]. It consists of investigating and defining problems, hypothesizing, designing experiment, collecting data, and drawing conclusions stages.

Various studies demonstrated the ability of inquiry learning strategy to develop knowledge and skills that support students' scientific literacy. Learning outcomes, science process skills, problem-solving skills, and attitudes toward science could evolve through hands-on activities of inquiry-based science learning [10] [11] [12] [13]. The use of the guided inquiry model was effective for training students' literacy skills [14], understanding of scientific concepts and literacy [15] [16] and learning becomes more active in focusing the mind in the process of formulating and solving the problems [17]. Students responded well to the implementation of inquiry learning strategy through the gradual application of learning from direct instruction, guided inquiry to free inquiry in chemistry learning. The students prefer free inquiry strategy, although the best mark of understanding of chemical concepts and process skills was achieved through guided inquiry [12].

This study examined the implementation of guided inquiry model to increase students' conceptual understanding and scientific literacy on electrolyte and nonelectrolyte materials. The learning strategy supported by utilization of environmental learning resources included the use of various electrolyte and nonelectrolyte solutions from local fruits, the use of current sources from the citrus fruit chain and the use of waste tools around us. Utilization of tools and materials from the environment was expected to provide more meaningful learning, a good conceptual understanding and scientific literacy. It also may raise nurturance effect of instruction as motivation, curiosity and environmental awareness.

2. Method

This classroom action research conducted at SMA Negeri 1 Banjarmasin of tenth grade of class IPA4. It involved 35 students, a teacher and three observers in two cycles of action on the electrolyte and nonelectrolyte learning. The scientific literacy and cognitive learning outcomes data were measured using multiple choice test with 10 items respectively. Meanwhile, teacher activities and student activities data were measured using observation sheets during the instruction. All the instruments used have validated by 6 experts and to be stated valid with content validity ratio (CVR) score of 1 or above the minimum value for 6 validators of 0.99 [18]. The teacher activities and student activities data were analyzed qualitatively. Meanwhile, scientific literacy and conceptual understanding data were analyzed quantitatively. Teacher's activities, and students' activities were rated by using Likert's scale 1-4. Depend on the number of indicator measured, teacher's activities score were categorized as 56-68 is very good, 43-55 is good, 30-42 is moderate, and 17-29 is poor; meanwhile, students' activities was categorizes as 56-68 is very active, 43-55 is active, 30-42 is moderate and 17-29 is poor.

3. Result and Discussion

3.1 Teacher Activities

Figure 1 shows the applicability of guided inquiry strategy in classroom action. The aspects observed consist of (1) greeting (2) delivering apperception (3) giving opportunity to argue or ask (4) conveying learning objectives (5) dividing students into groups (6) explaining learning model and environmental utilization (7) formulating problem (8) guiding propose hypothesis (9) guiding collect and analyze investigation data (10) asking students to discuss answers of the questions in the worksheet (11) asking students to present their works (12) asking students to respond the presenting data (13) giving feedback 14) giving students opportunity to ask (15) guiding students to make research conclusion (16) guiding students to make lessons conclusion (17) giving follow-up.

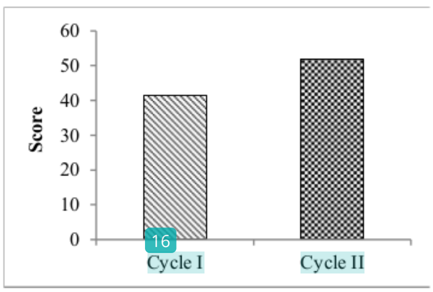

Figure 1. Teacher activities

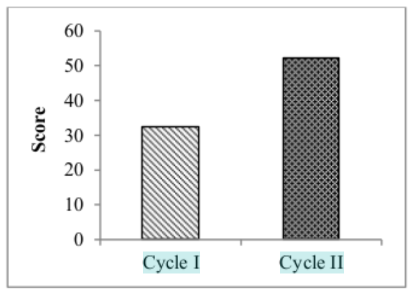

Figure 2. Students' activities

In cycle I, teacher still found difficulties in guiding students on guided inquiry learning stages because the students were not fussed with this strategy that required them to be active during the learning. It made the students tend to be passive so that the task was given by the teacher could not be completed on time. In addition, teacher was less likely to give students opportunity to pose an opinion or question about some things they did not understand, yet. Sometimes teacher focused only to the students who asked questions while the passive students were ignored. Other thing which needs to be improved is how to guide students during they were discussing and analyzing data.

In cycle II, teacher more assertive in giving direction and explanation in each lesson so that the learning atmosphere was more conducive. Teacher tried to motivate and provoke the students' curiosity so that they were more courageous to pose their opinion and question. Teacher could correct her deficiencies activities in cycle I by giving more equitable guidance and did not focus on the active students only. Learning to teach is not just a matter of acquiring the most important technical skills, but the important thing is the role of teachers in understanding the relationship in teaching and learning activities and teacher is responsible in achieving the highest standards of behavior [19] [20]. Teacher was able to improve the implementation of guided inquiry strategy in class management from moderate in cycle I to good category in cycle II. These results were in line with [21] and [22] that teacher activities increase at each cycle during implementation of guided inquiry models by a scientific approach. According to [23] the success of teachers in managing classroom was caused by teachers' appropriate scaffolding to students so that they effectively improve their learning.

3.2 Students Activities

Figure 2 shows the student activity observed at each meeting. The observed aspects consist of (1) answering greeting, (2) observing apperception, (3) daring to argue or ask, (4) paying attention to learning objectives, (5) forming groups, (6) paying attention to teacher instruction about learning model and utilizing environment, (7) formulating problem (8) proposing hypothesis, (9) collecting and analyzing the investigation data, (10) discussing the answers of questions in the worksheet, (11) presenting investigation result, (12) responding to presentation, (13) paying attention to feedback, (14) asking the unintelligible, (15) making conclusion of research (16) making conclusion of the lesson, (17) doing the follow-up task.

As the quality of teacher activities increased, the student activities increased too. In cycle I students' activity was categorized as moderate with score of 32.5 then it increased become 52.4 at cycle II which was categorized as active. In the first cycle students appeared to be poor skilled in asking and arguing, these were due to the lack of opportunity and guidance from the teachers as well as the lack of curiosity and motivation. In addition, discussion between groups did not take place optimally during the presentation of work. Many groups did not respond to the other groups who presented their work. In cycle II students were able to follow the teacher's guidance at each stage of inquiry well. Students' activities improved in all aspects so that learning took place dynamically based on the syntax of guided inquiry model. Students seemed more enthusiastic to follow the chemistry learning.

According to [14] the use of inquiry models could increase student activities, especially in performing analyzing activity and responding to presentation of other groups. The analyzing activity was the activity of students in their group in the form of discussing or exchanging opinions between group members in solving the problem. Students were able to build their concepts from the activity of solving phenomena both through experiments and connecting it to their daily life.

3.3 Conceptual Understanding Learning Outcomes

Figure 3 shows the students' conceptual understanding of electrolyte and nonelectrolyte. The improvement of teacher and student activities as well as increasing of other learning outcomes gave a positive effect to students' conceptual understanding. In the first cycle the students' mastery level of chemistry material was categorized as low (64.86%) with the level of classical completeness 51.42% or below the minimal completeness criteria of 75%. In cycle II, along with the increasing quality of teacher and students' activity, their mastery level of chemistry material increasing to be 84.86% was categorized as high with the level of classical completeness of 91.43%.

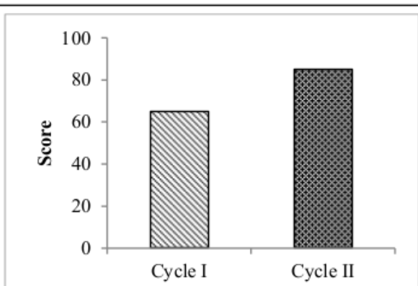

Figure 3. Students' conceptual understanding

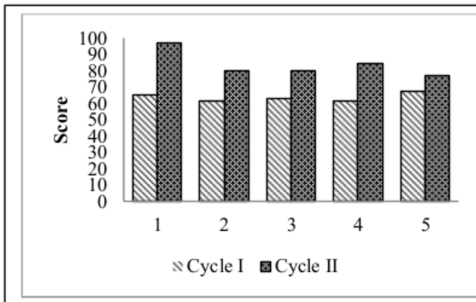

Figure 4. Students' scientific literacy

Many studies reported the effectiveness of the inquiry learning strategy in improving students' understanding of science concept. Students' learning outcome after followed instruction by using inquiry learning strategy better than by using conventional learning strategy [24]. Through classroom action research in two cycles with guided inquiry strategy, students' learning completeness in knowledge aspect increased from 56% in cycle I to 84% in cycle II [25]. According to [26] mastery of the concept can occur because learning with inquiry model encourages students to think and participate in the process of acquiring knowledge and constructing the concepts. Thus, the students' memory toward the concepts obtained would be retained longer than if they were only received from the teacher. Ref. [27] also reported that inquiry learning collaborated with utilization of environmental learning resource gave a positive contribution to student's achievement until 83.33% in Cycle II. Meanwhile, Ref. [28] said that learning with the learning source of real environment using guided inquiry gave the more positive achievements.

3.4 Scientific Literacy

Figure 4 shows the students' scientific literacy as a result of the class action. The scientific literacy assessed consist of indicators (1) repeating and applying appropriate knowledge, (2) cultivating and justifying appropriate predictions, (3) proposing a way of exploring problems scientifically, (4) evaluating arguments and scientific evidence from different sources, and (5) analyzing data and drawing appropriate conclusions. There was increasing of scientific literacy from low (63.43%) to high category (83.72%). Each scientific literacy indicator increased significantly. It was as the effect of teachers' improving effort to the classroom actions by emphasizing activities as well as increasing the chemistry conceptual understanding.

The increasing of scientific literacy on this research in line with the report that inquiry learning was an excellent way for students to understand the scientific content associated to scientific literacy [29]. In addition, learning through laboratory activity could improve the ability of scientific inquiry and scientific literacy of students [30]. According to [31] to increase scientific literacy, guided inquiry-based learning strategy was more effective than lectures strategy on heat material for grade VII of secondary students. The ability of the guided inquiry model to increase students' scientific literacy [16] [32], since the stages of model were able to direct students to learn through questioning, fact-based learning, fact-based explaining, linking explanations with knowledge, communicating, and strengthening explanations.

This study proofed that the guided inquiry learning strategy with the environment learning resources was effective in increasing students' learning outcomes and scientific literacy. It was able to build student involvement optimally in learning activities through the steps of scientific method. It was also able to facilitate meaningful learning. Therefore, guided inquiry was able to instill knowledge with better retention and train the process skills as the important part of scientific literacy. The good scientific literacy will produce learners who are not only understand the concept but are also able to use their knowledge to explain the phenomenon scientifically and to solve the problems encountered.

Teachers seem more assertive in giving direction, explanation and guidance to change the students' performance in cycle II. Cooperative interaction between students occur in guided inquiry activities and increased along the classroom meeting. Several studies showed an increasing in learning outcomes due to increasing student activity. Guided inquiry learning model could improve students' self-confidence, communication, diligence, discipline, cooperation, honesty, greetings and prayer aspects [33], students' responsibilities for the assigned tasks provided a positive impact so that the learning objectives could be achieved and it gave a good influence on student achievement [34].

4 Conclusion

Implementation of guided inquiry model with environment learning resources was proofed increased the quality of both the teacher and students' learning activity. Increasing the learning activities have affected in improving students' conceptual understanding and scientific literacy indicators. This study show that students' conceptual understanding of chemistry increased from the classical completeness level of 51.42 to 91.42% and scientific literacy from low to high category. It means that the learning model was effective in increasing of quality learning process, students' conceptual understanding and scientific literacy.

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