

Integration of Student Generated Representations (SGRs) in Learning Cycles 5E towards Students' Senior High School Conceptual Comprehension

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Abstract— This study aims to determine how the impact of the integration of Student Generated Representations (SGRs) in improving senior high school students' conceptual comprehension as well as finding out the consistency of the strategy applied in two different concept samples. Thus, a learning design called counter balanced was employed. On the concept of expansion and the influence of heat to temperature and state of substance, average score of N-gain in experimental class was higher than in the control class. In the next concept, Black principles and heat movement, the exchanging of learning strategy was conducted. The result showed that average score of N-gain in the experimental class was higher than in the control class. Thus, the integrating on of SGRs strategy is consistent in improve students' conceptual comprehension. In addition, students' conceptual comprehension was generally improved in each aspect, and each aspect obtained different score categories. The average N-gain score of students' conceptual improvement is 0.44, and thus included into medium category. Therefore, the integration of SGRs in Learning Cycle 5E gives positive impact on students' conceptual comprehension, specifically in the subject matters 'heat and temperature'.

Keywords— Concept Comprehension; SGRs; Learning Cycle 5E

I. INTRODUCTION

The educational system in Indonesia has changed from teaching to learning. Learning is an interaction process of students, teachers, and learning sources in a learning environment. Learning also can be defined as the transforming process from former circumstance to the latter one through a series of activities involving students and teachers. The learning process is planned, conducted, evaluated, and monitored in order to obtain effective and efficient outcome. In addition, the educational system in Indonesia is subjected to the curriculum demand regulated by the government.

However, the implementation of teaching and learning in senior high school curriculum in the Indonesian schools is not the same yet.

2013 curriculum states that the learning objective is to increase and balance students' soft skills and hard skills, consisting of behavioral aspect, skills, and knowledge. Soft skills are the capacity to be well-behaved students while hard skills are skill and knowledge for living appropriately. Thus, the learning process at schools is administered to the use of scientific approach (Ministry of Culture and Education, 2014).

2013 curriculum contains basic competences as the minimum competences that should be achieved by students. Competences achievement is called the learning outcome taken from the subject matter taught. The competences itself consists of cognitive, psychomotor, and affective process. The most important cognitive aspect that should be developed is students' conceptual comprehension. Starting from conceptual comprehension, students will be able to use concepts in any fields and take a lot of advantages from it to solve the problems in society. Concept is an abstract thing that represents a phenomenon. The students' capacity to comprehend the concepts is one of the learning objectives, providing an understanding that the subject matter taught is not just a kind of memorization, but it is more than that. By mastering concepts well, students will be able to comprehend the concepts of each subject matter being learned. Thus, a learning model and strategy is needed to facilitate conceptual comprehension well and correctly.

Building concepts is something forgotten by the teacher. Most students serve the concepts just like serving a dish on the table. Students are spoon-fed. Teachers do not engage students to build the concepts by themselves. Indeed, if the teachers use

the model in serving the concept, it could not provide the best outcome and could not stay longer in students' memory. Besides, teachers tend to explain the concept by using words and mathematical similarity. They tend to follow the textbooks provided by the school without modifying them. It is known that students come from different economical, and intellectual background as well as having different preferred learning styles. In this case, a teacher has to be able to facilitate students' learning needs by using various kinds of representative modus that can facilitate students in comprehending and building the concepts. Regarding building the concepts done by students, Kenny (2015) introduces a learning strategy is called *student generated representations* (SGRs) in which students are demanded to build the concepts through some representation. The use of the strategy has been applied by two people involved in teachers' professional development program. Building students' concept through representation is not as easy as we think. To achieve this, we can use various kinds of strategy and method. One of them is by applying learning cycle.

Learning cycle 5E is a learning model which applies constructivist approach. Constructivist perspective contains four main activities, namely: 1) dealing with students' prior knowledge; 2) involving factual experience activity; 3) involving social interaction; 4) making students aware of their surrounding (Dahar, 2011). Constructivism must involve factual experience activity that can be done through practical. In 1997, Bybee developed Learning cycle 5E, comprising of engagement (encouraging or correlating), exploration, explanation, elaboration, and evaluation [Tuna & Kacar, 2013]. Each 'E' in LC shows sequential processes to help students learn from their experiment and then correlate with the new concepts (Calik & Mehmet, 2008). Evaluation could be found in each phase of learning cycle (Ajaja et al, 2012). The results of study show that learning activities which is based on LC 5E model is the most effective strategy to increase competence achievement or that's so called 'students' learning outcome' (Taslidere, 2015). The use of learning cycle model 5E; engagement, exploration, explanation, elaboration, and evaluation proves the improvement of students' knowledge, comprehension, and conceptual mastery in any levels; junior high school level, senior high school level, and university level (Tuna & Kacar, 2013; Artub & Costu, 2012; Liu et al, 2009; Balci et al, 2006). This research would conducted combination of learning cycle 5E that integrated SGRs in same time.

II. RESEARCH METHOD

A. Research Design

The design employed in the present study is counter balanced design (Fraenkel, 2012). The design was employed to compare the effectiveness of the model used. However, the design was modified by adding pre-test and post-test before and after the teaching and learning process conducted. The research design shown in Table 1.

B. Samples

Samples were selected from a population using purposive sampling technique. Fraenkel (2012) explain that on occasion,

based on previous knowledge of a population and the specific purpose of the research. Samples was discussion result of researcher, teacher and vice of head master. In other words, from nine existing classes, we take 2 classes as samples as result of discussion. The samples used in this study are class X MIPA 6 and X MIPA 9. For the session 1 and 2, class X MIPA 6 was used as an experimental class while in the meetings 3 and 4, the class X MIPA 9 was used as an experimental class.

TABLE I. RESEARCH DESIGN

| Groups | Pre-test | Treatment | | Post-test |
|--------|----------------------------------|---------------------------------|---------------------------------|----------------------------------|
| | | 1 | 2 | |
| A | test of comprehension conceptual | integration SGRs in model LC 5E | model LC 5E | test of comprehension conceptual |
| B | test of comprehension conceptual | model LC 5E | integration SGRs in model LC 5E | test of comprehension conceptual |

C. Instruments

The instrument used to measure students' conceptual comprehension was multiple-choices test with five options. The test consists of 21 questions that represent each concept of the learning material taken. Those questions were developed based on the indicator of conceptual comprehension (C2) of Bloom revision. Having tested through test retest technique, it is found that the test reliability is 0.59 which is categorized into medium category.

III. RESULTS AND DISCUSSION

Table 2 presents the mean scores of post-test from the overall students' conceptual comprehension in the two classes.

TABLE II. SCORE OF COMPREHENSION CONCEPTUAL

| Group | Score 1 | Score 2 | Mean |
|------------|---------|---------|-------|
| Experiment | 88,97 | 80,48 | 84,72 |
| Control | 75,19 | 82,04 | 78,62 |

Scores in Table 2 are post-test scores obtained by experimental and control classes. The average scores of experimental class described in Table 2 are the average scores of combined post-test in class A (as an experimental class) and class B (as an experimental class). Meanwhile the average scores of control class are the average scores of combined post-test in class A (as a control class) and class B (as a control class). Score 1 is average scores of concept expansion and the influence of heat to temperature and state of substance whereas score 2 is average scores of concept Black principles and heat transfer. In general, the average scores obtained by the class in which a learning model 'cycle 5E' integrated with learning strategy 'SGRs' was applied are better than the class in which only a learning model 'cycle 5E' was applied (without integration).

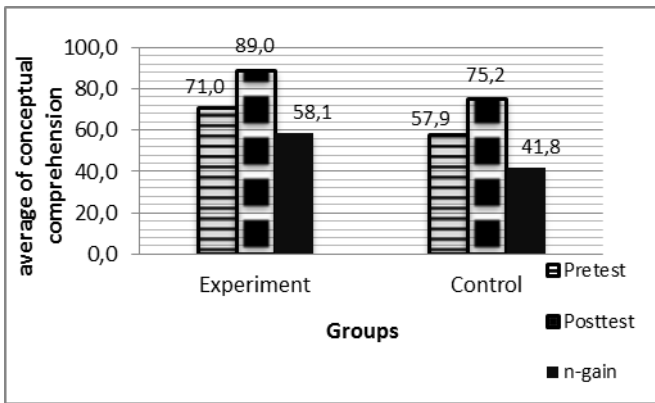


Fig. 1. The Diagram of average score comparison in the experimental class (class A) and control class (class B)

Figure 1 shows the average scores of pretest, posttest, and N-gain for the students' comprehension of the concepts 'expansion' and 'substance form changing' before and after teaching and learning process in experimental and control classes. The average of N-gain showed significant improvement from pretest scores to posttest scores. The students' improvement of conceptual comprehension in the experimental group is 0,58. If it is confirmed to the categorization formulated by Hake (1999), the students' improvement is categorized into medium category. Meanwhile in the control class, the average score of N-gain is 0,42 and is also categorized into medium category. Based on the analysis of N-gain data quantitatively, it is found that the experimental class obtained higher N-gain score than the control class. This improvement reveals that the integration of SGRs in the 5E learning cycle can further enhance students' conceptual comprehension regarding the concepts 'expansion and 'the influence of heat towards temperature and substance form' than the manipulation of 5E learning cycle without any integration with SGRs. To find out if the integration is consistent or not, learning model changing in experimental and control classes was conducted.

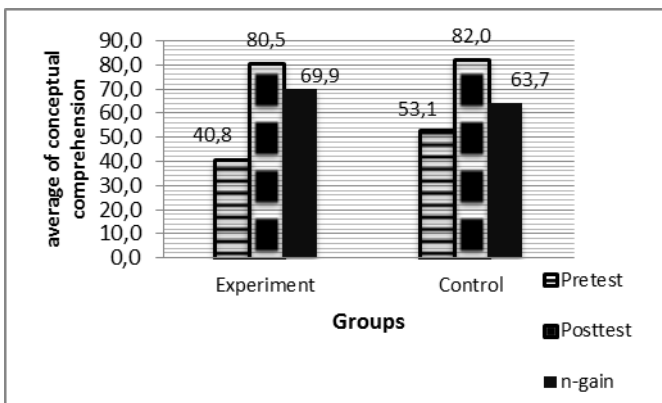


Fig. 2. The Diagram of average score comparison in experimental class (class B) and control class (class A)

Figure 2 shows the average scores of pretest, posttest and N-gain for the students' comprehension concepts 'Black Principle' and 'heat movement' after exchanging the learning model between the two classes. The average scores of N-gain in experimental and control classes are 0.70 and 0.64. The

students' conceptual improvement reflected by the average scores of N-gain shows a difference where the average scores of N-gain in the experimental class were higher than the average scores of n-gain in the control class. Although the differences of the average scores of N-gain is not significant, the class in which the integration of SGRs in LC 5E was applied obtains higher score than the class in which LC 5E was applied without any integration with SGRs.

The results of the study show that the integration of SGRs in LC 5E is able to improve the students' conceptual comprehension although it was applied in two different samples. Given this consideration, it could be stated that the integration of SGRs in LC 5E can improve the students' conceptual comprehension consistently. This consistency is totally needed in selecting an appropriate learning strategy to improve the students' conceptual comprehension, specifically on the subject matters 'temperature' and 'heat'. Thus, a teacher does not only apply the strategy in a certain sample.

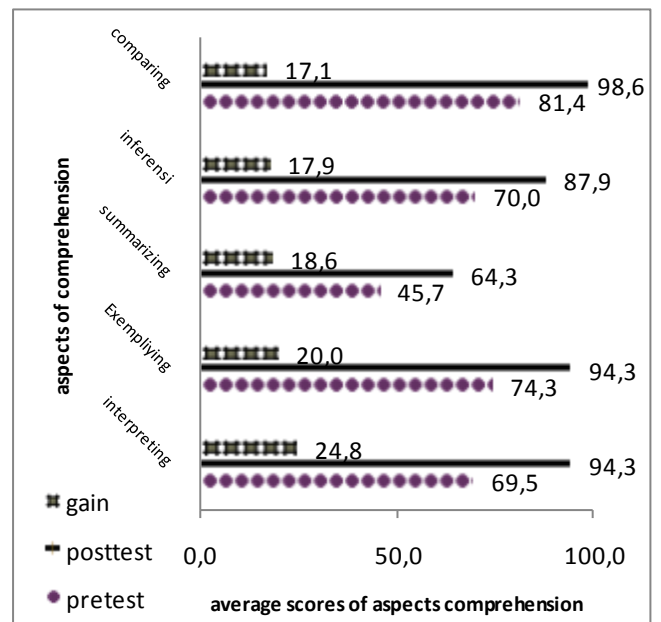


Fig. 3. The diagram of conceptual comprehension aspect improvement in the experimental class (class A)

Figure 3 and Figure 4 show conceptual comprehension aspect improvement in all sub concepts measured in the present study. In general, each conceptual comprehension aspect obtains an improvement although the improvement is not the same. Conceptual comprehension aspect improvement is consistent in two classes. Both of class A (the first experiment) and class B (the second experiment) improve each conceptual comprehension aspect consistently. Thus, the integration of SGRs gives positive impact on the improvement of each conceptual comprehension aspect.

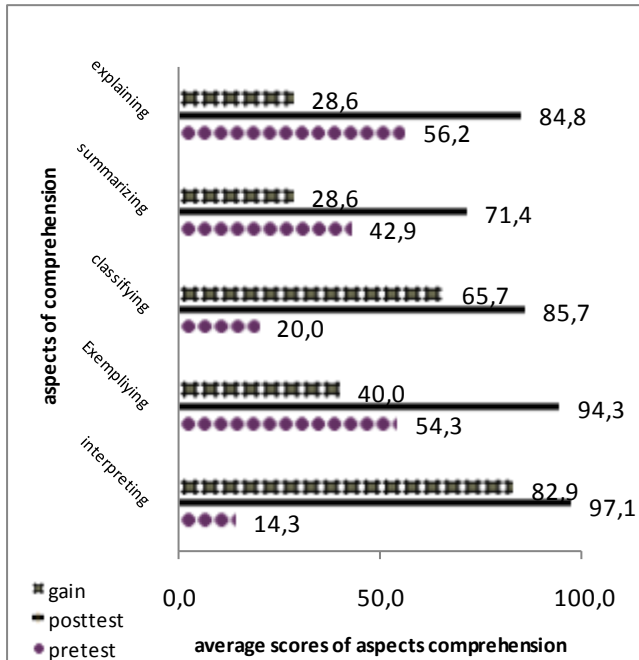


Fig. 4. The diagram of conceptual comprehension aspect improvement in the experimental class (class B)

SGRs learning strategy gives students the chance to represent what is known from a phenomenon in the form of representation such as text, picture, or verbal. The representation made by students will help them build the concepts in their minds. The conceptual built enables students to comprehend the concepts and of course it will be much easier for them in applying the concepts comprehended in the new or in different situations. In addition, Development of this concept helped students understand concepts and of course easy to use concept has been understood in other situations or new situations. In addition, the representation made by students will be easily remembered by the students themselves. The findings support the finding from previous research conducted by Parnafes (2014) in 2012. His study focuses on the implementation of SGRs learning strategy and find that the learning process through SGRs strategy supports the process of self-conceptual built.

The improvement is totally dealing with the use of some representation during the teaching and learning process. The representation is in the forms of video, verbal, picture or symbol. The use of representation in the learning process is intended to stimulate students to represent their comprehension through various forms of representation they wish. Thus, the students will comprehend the concepts easily. The result of the present study is in line with the finding from the study conducted by Adadan (2012) which states that multiple representation plays an important role in improving students' cognitive and affective sides. It does not only has a potential to attract students' attention, but also has a potential to develop students' conceptual comprehension.

IV. CONCLUSION

The integration of SGRs in LC 5E learning cycle improves senior high school students' conceptual comprehension on the subject matters 'temperature' and 'heat'. The average scores of students' conceptual comprehension aspect improvement is 0.44 and thus is included into medium category.

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