

Exploring Generic Skill of Student in Science through Disconnection Approach in Organic Synthesis

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Abstract—The study aims to determine to students' generic skill in science by learning disconnection approach in organic synthesis. Participants of this study were 16 students from the department of chemistry education from one of state universities in Indonesia. The research method was a quasi-experimental by using only one pre-test and post-test group design. The data shows that the highest N gain value of generic skill in science was found in indirect observation that have N gain 0.8 and the lowest value 0.446 in logical consistency questions. While in the concept of formation and the causality had N gain value of 0.596 and 0.634, respectively. Moreover, the N gain value in indirect observation had high criteria, but the other indicators had medium criteria.

Keywords—exploring; students' generic skill in science; disconnection stages problems; synthesis organic compound

I. INTRODUCTION

Generic skill become one of the important skills that help people to work in all fields in the era 4.0 Industrial Revolutionary. Generic skill become benefits for the employees in constructions industry in order to have a good achievement for their jobs [1]. Similarly generic skill was required for students to become effectively and efficiently practice in a digital era academic library [2]. Dealing with the previous study, it is not just the adult as the employees who need the generic skill but it is necessary for all undergraduate students. Students need to practice their generic skill for their future work [3,4]. It is found that young children should be given exercises the generic skill in order to face the reality in their daily life [5].

However, we cannot perceive that students' generic skill work together with all the specific domain knowledge, because it is not affected each other. But it will impact if we combine the specific generic skill with the specific domain knowledge. It make their specialization and differentiation in knowledge become higher than before their combine the generic skill and the specific domain skill [6,7]. Likewise, in the science knowledge, the students must combine their knowledge of science with the generic skill to learning science. It is related one to another. The generic skill in science will help students more easily in learning science. The indicators of generic skill in science are: direct and indirect observation, sense of quantity, symbolic language, principle framework, logical self-

consistency, logical inference, the causality, mathematical modelling, and concept formation [8]. In case for study science, students must develop their generic skill in science to make the constructive alignment with their science knowledge skill or in order to combine with the other discipline area such like in STEM [9,10].

As the other fields in science, chemistry is knowledge that includes natural phenomena, substance structure and composition, change of matter and energy that accompanies those changes [11]. Chemistry also have a sub discipline like organic chemistry that learned about the structure and properties, energy, stability, intermediate, regioselectivity of product and mechanism reaction of organic compounds [12].

Even though, the problems of organic synthesis consider as a difficult thing that has been solved by students. Therefore, students need to have the generic skill to embed synthesis of organic compounds. Students need to have generic skill in order to successfully solve the problems to synthesize organic compounds. For that reasons, some studies also used problem solving methods to synthesize organic compounds as scaffolding [13,14]. The problem solving is known can improve generic skill in science and critical thinking [15,16]. Problem solving approach has often been used to answer the problem of organic synthesis. Students need to have generic skill in science in order to successfully solve the problems to synthesize organic compounds.

This research focus only on some aspects such as the characterize of compounds, regioselectivity, stereo selectivity, reagent, type of reaction ad condition of reaction that are considered important in synthesis of organic compounds [17]. Therefore, this study will notice from disconnection approach of organic synthesis problems. Based on previous research [15], it was emphasized how the ability of students to solve a problem of synthesis of organic compound. Unfortunately, there is no exist research investigate the student's generic skill in science with the disconnection approach problems in organic synthesis compound. This study used the test to recognize student's generic skill in science for solving the disconnection problems. Consequently, the objective was to explore the generic skill in science of students in disconnection stage problems.

II. METHOD

This research was a quasi experimental by using one group pre test-post test design. Data were collected from the results of the essay test about the disconnection approach problems. The participants of study were 16 students in the fourth year of one of the state university in Indonesia. The student has attended lectures on organic chemistry 1, 2 and advanced organic chemistry.

The data were collected from the essay tests on disconnection approach of the synthesis of molecular target compounds and to emphasize the results of their answers. To find out the generic skill in science of students related to disconnection approach, we focus on indicators of the generic skill in science of students on: (1) indirect observation; (2) causality; (3) concept formation; and (4) logical self consistency.

Instrument of this study was using test pre-test and after treatment (post-test). Moreover, from the results of the pre-test and post-test used for perceive the value of N gain to find out the proportions of the difference. The criteria for the pre-test and post-test implementation can be seen in table 1.

TABLE I. CATEGORY OF GENERIC SKILL IN SCIENCE

No	Criteria N gain (g)	Category
1	$g \geq 0.7$	High
2	$0.7 > g \geq 0.3$	Medium
3	$g < 0.3$	Low

Table 1 shows the N gain value that used to determine whether there is a difference in student generic skill in science based on pre- test and post-test. For this study, the indicators that contained in this problem are constructing the concept of student answers. It will used as a data. Then it processed to determine the N gain of pre-test data and post-test data. Moreover the result showed students' answers to the essay test concerning the synthesis of the target molecular compounds. It was perceived students' generic skill in science. In addition, from the acquisition of student N gain that based on the score obtained the N gain of the generic skill in science of students who are in the lowest and highest category.

The instruments used to measure generic skill in science were 12 item of test essays on disconnection approach of the synthesis of target molecular compounds. The example of essay test was given in figure 1.

Sample of essay test:

Based on regioselectivity of the compound, which one of the structures is more stable and is the main product of two molecular isomers produced if the methoxide compound dissolve in methanol? Explain your answer (score 4)

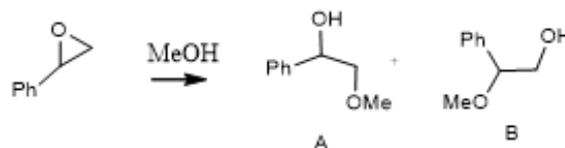


Fig. 1. Examples of essay tests related to disconnection approach.

In figure 1, it can be seen that the problems given to students are based on the disconnection stage of the target molecular compound. In this case the problems are related to regioselectivity molecular target compounds that will be synthesized by students through disconnection approach.

III. RESULTS AND DISCUSSION

Students need to have generic skill in science in completing the synthesis of a target molecular compound. In the synthesis of molecular target compounds there is a disconnection approach from the target molecular compound. It is also known that students' generic skill in science omitting organic compounds requires the integration of various basic concepts that have been owned by students. In this study, the implementation of synthesis in organic compounds was related to generic skill in sciences. It can also be seen the differences between each indicator of students' generic skill in science. The results of generis skill in science test of students in performing the disconnection of organic compounds are shown in table 2.

TABLE II. RESULTS OF N GAIN ON STUDENT GENERIC SKILL IN SCIENCE

Indicator Generic Science Skill	Concepts	Pre Test	Post test	N gain	Category
Indirect Observation	Characterize target molecule	12	28	0.8	high
Logical selfconsistency	Stability of starting material structure	25	46	0.446	medium
Causality	Regioselectivity and Stereoselectivity	21	47	0.634	medium
Concept formation	Combine the reaction type, reagent and condition of reaction	24	37	0.596	medium

Based on the data in Table 2, it can be seen that overall indicators of generic skill in science are in the medium category. However, if it was examined distance, we found that the highest N gain from all groups in the generic skill in science is indirect observation indicator of 0.8. Furthermore, all other generic skill in science indicators are in the medium category.

The distribution of N gain value of generic skill in science indicator as in figure 2.

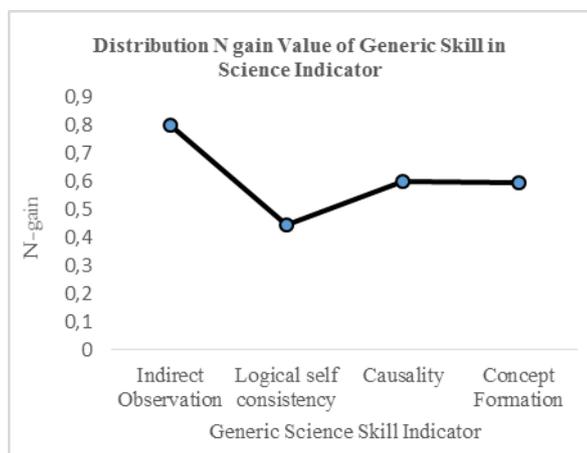


Fig. 2. Distribution of N gain value of generic skill in science indicator.

Based on figure 2, even all indicators of the disconnection approach are in the medium criteria but the indirect observation indicator shows a high increase. It is possible because students are familiar with the problem of the synthesis of organic compounds given [17]. It has resulted in getting problems related to the synthesis of the compound, so students become easier to solve and develop the generic skill in science they have. If you see the distribution of N gain value known that the indirect observation indicator has highest N gain value. Then the curve decreases until the logical self-consistency indicator.

The results of learning organic synthesis by using disconnection approach can also be displayed the results of pretest and posttest on 4 (four) indicators of generic skill in science as follows in figure 3.

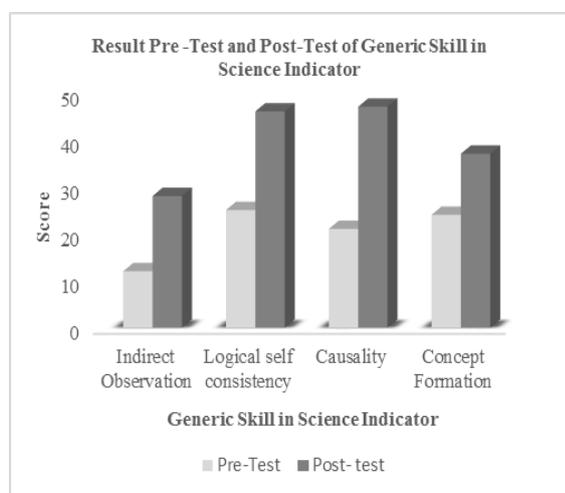


Fig. 3. Distribution of N gain value of generic skill in science indicator.

From figure 3 it is known that the smallest student pretest and post test results are on the indirect observation indicator. Nevertheless, the indirect observation indicator has the highest N gain value. When all post test scores were seen, the generic skill in science indicator of causality has the highest score. But the N gain lower when compared to the score of the indirect observation indicator. The N gain value of indirect observation indicator become higher because of the significant increase score after the post test. When it was compared to concept formation indicator found that the logical self-consistency indicator has the posttest higher than concept formation indicator. But according to the N gain value found that the logical self-consistency indicator has lower than indirect observation indicator.

Based on the results obtained, there is still a lack of generic skill in science owned by students, it is necessary to make a research based on authentic and real problems that similar to the complex problems that faced by scientists which have an impact on students' generic skill in science and study independently, and deeply gain learning experience. This is a process of assimilation that must be passed by students to be able to turn into practitioners or scientists in the field of organic chemistry [15]. In addition it can also be done through laboratory activities which leads to experiments on the synthesis of organic compounds through guided investigations [18]. Through the presence of scaffolding used is expected to help to direct students towards conceptual change and in addition to improving students' critical thinking skills.

IV. CONCLUSION

The finding of this research revealed that the highest N gain value in generic skill in science was found in indirect observation while the lowest N gain was found in logical consistency questions. Furthermore, in building the concept and the law of cause and effect have N gain values in medium category. The value gain in indirect observation has the high criteria, but the other indicators have medium criteria. A significant increase was found in post test scores in this research which stated that the positive impact of organic synthesis learning using the problem of disconnection approach on the generic skill in science of student. Therefore, study more deeply in later research are needed to know how the relation between students' generic skill in science with another skill.

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