CE-6

IMPROVING THE LEARNING PROCESS OF POLIFUNCTIONAL COMPOUND TOPIC BY USING JIGSAW COOPERATIVE LEARNING WITH MULTI LEARNING RESOURCES

Mitarlis, Sri Hidayati Syarief, Nurul Hidayati, Suyatno and Tukiran

Department of Chemistry, Faculty of Mathematic and Natural Sciences, Surabaya State University
Email: mitarlis@ymail.com

ABSTRACT

Organic Chemistry lecture had been held in the classroom meeting and laboratory experiment activity. Many topic were conducted experiment in laboratory activity representatively, such as the alcohol phenols, carboxylic acids, aldehydes ketones as well as other topics. Especially on poly functional compounds are not specific experiment title. Therefore the learning process of polyfunctional compound needs to be improved. The aims of this study to describe the implementation of Jigsaw Cooperative Learning Model in order to enhancing the learning process of Organic Chemistry 2 lecture on polyfunctional compounds topic. It used multi learning resources during the lecture. The study design used one shot case study post-test only design. Methods of data collection used observation, interview, and test methods. Data analysis used descriptive quantitative and qualitative. The study result shown that: The implementation of Jigsaw cooperative learning Model of all components of the average of the 3 observers get a score of 3.49 in good categories; almost all stages of Jigsaw Cooperative learning get score between 3.33 to 4.00 on good and very good category, except the award given syntax obtain an average score of 2.33 in quite well category; learning resources and media usage get score between 3.66 to 4.00 on very good category. The student learning outcome in polyfunctional compound topic with the details value of A^- to A 12.9 % ; B^- to B^+ 77.9%; and C^+ 7.4% on mastery learning category; as well as D 1,8% and E 0% on not mastery learning category. The students response about this learning, they interest on the matter 9.1%; learning process 66.7%; and learning resources 21.2%.

Keywords : polyfunctional compound , Jigsaw cooperative learning, multi learning resources.

INTRODUCTION

Organic chemistry is one of the compulsory subjects that must be taken for chemistry students and chemistry education students of chemistry department in Faculty of Mathematic and Natural Sciences Surabaya State University. The course consists of Organic chemistry I (2 credits), Organic chemistry II (3 credits), Organic Chemistry III (3 credits) and Organic Chemistry IV (2 credits) [**1**]. *Organic Chemistry* is one of the most important courses for second year undergraduate students majoring in chemistry especially Organic Chemistry 2 was hold on odd semester for student chemistry program study and even semester for student of education chemistry program study. In our teaching and learning process, the most commonly used teaching methods include lectures in classroom and doing experiment in laboratory. There are many topics in Organic chemistry 2 course. Course description are discussing about structure physical and chemical characteristics, as well as it synthesize, consists of alcohol

compound; phenol; eter; aldehyde; keton; carboxylic acid and it derivates; amine; and polyfunctional compound. These topics were studied by learning activity in the class and doing experiment in the laboratory. The titles of the experiments represent the topics in course except polyfunctional topic there is no experiment title representatively. So the learning process of this topic needs more interesting and makes students more active. Student activity in ordinary learning process is not high. It's indicated when the lecturer gives question to the students; almost all of them were not give response until the third question. There are less than 10% only of students give answer, or 3 students from 54 students. This condition is very passive class.

There are many learning models had been develop to improve learning process, like cooperative learning, direct instruction, problem based learning, and others. The models can applied on many subject, or topic according to characteristic of them. In chemistry subject, we can apply one of the models, especially for polyfunctional compound topics. The polyfunctional compound topic in this course divided into 7 sub topics mainly dicarboxylic acid; double functional ester; hydroxyl acid; phenolic acid; keto acid; dicarbonyl compound; and diene compound**[2]**. The discuss about structure, characteristics, and specific basic reaction for each compound. Based on the characteristics there are many sub topics, the learning process can conduct by using cooperative learning model especially Jigsaw type.

The Jigsaw method is a cooperative learning technique in which students work in small groups. Jigsaw can be used in a variety of ways for a variety of goals, but it is primarily used for the acquisition and presentation of new material, review, or informed debate. In this method, each group member is assigned to become an "expert" on some aspect of a unit of study. After reading about their area of expertise, the experts from different groups meet to discuss their topic, and then return to their groups and take turns teaching their topics to their group mates. One of the benefits of the jigsaw process encourages listening, engagement, and empathy by giving each member of the group an essential part to play in the academic activity. Group members must work together as a team to accomplish a common goal; each person depends on all the others. No student can succeed completely unless everyone works well together as a team. This "*cooperation by design*" facilitates interaction among all students in the class, leading them to value each other as contributors to their common task **[3]**. (http://www.jigsaw.org/overview.htm).

Many students believe that the study of organic chemistry requires rote memorization. This is supported through the encyclopedic nature of introductory organic chemistry textbooks and their associated solutions manuals. However, help is available through an understanding of reactions and their underlying mechanisms. A reaction mechanism can be described using arrow pushing - the use of curved or curly arrows to show the movement of electrons through the various functional groups. Through this technique, applicable to any book or course, memorization can be minimized and the subject demystified. Of the many available online resources, this site focuses on making organic chemistry more approachable. There are many learning resources provide for students in this era. However when the globalization, market power, multinational, international as well as information technology advancement and the other trend in the world give influence significantly to the learning material, really we did not show yet a great changes in the teaching and learning process in college[4]. Learning resources were not teacher or lecturer only. In this research students can use textbooks, website by using their gadget, student book and worksheet as a guide of this activity. The problems will be answered in this study are: 1) How the implementation of Jigsaw Cooperative learning model in chemistry organic 2 on poly functional compound topic. 2) What the students learning outcomes on polyfunctional topic by learning process with cooperative learning model. 3) How the students response about learning process of organic chemistry II on polyfunctional topic.

This study aims to improve the learning process in the course of organic Chemistry 2, especially on the topic of polyfunctional compounds with Jigsaw cooperative learning by using a multi learning resources. In addition, to know the learning process of organic chemistry 2

subject on polyfunctional compound topic with Jigsaw cooperative learning by using multi learning resources, to know student learning outcomes and to student response. The benefit of this study is to provide an alternative learning model that can be used in the learning process of Organic Chemistry 2 especially on polyfunctional compound topic. For students with more learning can enable students in the learning process. For science, especially in learning process it can expand the using of learning models and multi learning resources in the lecture.

Benefits of learning resources are: can give direct learning experiences and real to students; present something that impossible to provide, visit or observe directly and really; can give wider presentation in the classroom; provide accurate and newest information; supporting to solve education/ instructional problem in micro or macro area; give positive information, if its benefits was regulated and planed precisely; can stimulate to think, posed, and develop furthermore**[5]**.

Which includes of learning resources are variety information, data science, human ideas , either in the form of printed materials (books , brochures , pamphlets , magazines , etc.) as well as in non-print form (movies , filmstrip , cassette , videocassette , etc.). Association for Education and Communication Technology (AECT) outlines that learning resources include: message, people, materials, tools, techniques and environments. All sources in the form of data, and the particular form that can be used by students in learning, either separately or combined to facilitate students in achieving the learning objectives or achieve a particular competence. Learning resource materials that are used and required in the learning process, which may include text books, print media, electronic media, speakers, surrounding environment; and so on that can increase the levels of students activity in the learning process. Learning resource is anything that is available around the learning environment that serves to help optimize learning outcomes. Optimizing the results of this study can be seen not only on the learning outcomes, but also the views of the learning process in the form of student interaction with a variety of learning resources that can provide a stimulus for learning and accelerate the understanding and mastery of science are studied **[6].**

Components of learning resources which used in the teaching and learning activities can be distinguished by the way that can be seen from the existence of learning resources as planned and utilized. Learning resources are deliberately planned (by design) are all sources of learning that has been specifically developed as a component of the instructional system to provide facilities-directed learning and formal. Learning resources as utilized (by utilization) that learning resources that are not specifically designed for learning purposes, but can be found, applied, and used for learning purposes. Based on the above concepts, learning resources is essentially an instructional system components include a message, people, materials, equipment, techniques and background (environmental) **[7].** http://www.m-edukasi.web.id/2013/07/pengertian-sumber-belajar.html. In this study learning resources was used in the classroom of Organic Chemistry 2 course on polyfunctional compounds are among others; student textbook of polyfunctional compounds, student worksheets, and other resources that are accessed from the internet through gadgets that owned by the students.

RESEARCH METHOD

The research design used one shot case study posttest only design. Methods of data collection in this research used observation, interview, and test methods. Data analysis used descriptive quantitative and qualitative. The instruments are used in this research; observation sheet of implementation of cooperative Jigsaw learning process using an instrument that adapted from the implementation of learning assessment instruments in the implementation Signs Professional Teacher Education and Training (PLPG) 2013 **[8]**. In this study, the instrument is modified as needed. Assessment scores using a range of 1 to 4, with criteria 1 =

less, 2 = adequate, 3 = good, and 4 = very good. Analysis of observational data using a learning instrument that has been compiled and analyzed quantitatively by the formula:

$$\text{Value} = \frac{\text{total score components}}{number\ of\ components}$$

Then the conversion described with ratings in the following categories:

Very well = $3.33 < \text{score} \leq 4$
Good = $2.33 < \text{score} \leq 3.33$
Adequate = $1.33 < \text{score} \leq 2.33$
Less = $\text{score} < 1.33$ **[7]**

Student responses to the questionnaire calculated the percentage of students answer according to the number of items in the instrument. The test results were analyzed according to assessment system based on the Criterion prevailing in the Department of Chemistry, State University of Surabaya presented on Table 1[1].

Table 1. Converse of value in letter and number

Value	Score	Interval
A	4.0	85≤ A ≤100
A^-	3.75	80≤ A^- ≤85
B^+	3.5	75≤ B^+ ≤80
B	3.0	70≤ B ≤75
B^-	2.75	65 ≤ B^- ≤70
C^+	2.5	60 ≤ C^+ ≤65
C	2.0	55 ≤ C ≤60
D	1.0	40 ≤ D ≤ 55
E	0	0 ≤ E ≤40

Beside the kind of quantitative data there are qualitative data that can support the results of this research will be analyze by using descriptive qualitative.

RESULT OF THE RESEARCH AND DISCUSSION

Feasibility of learning process in Organic Chemistry 2 course by using Cooperative learning Jigsaw type with the multi learning resource can be seen on Table 2.

Table 2. Observational data of Cooperative learning models Jigsaw type in Organic Chemistry 2 course on polyfunctional matter

Observation aspects	O1	O2	O3	Average
Introduction				
A. Apperception and motivation				
1. Creating learning situations to focus attention	3	4	4	3,66
2. Asking students to express their opinions	3	3	4	3.33
3. Conveying learning objectives	4	4	4	4
4. Linking the present with previous lesson	4	3	4	3.66
B. Conveying of Competence and activity plan				
1. Communicating student competencies to be achieved	3	4	4	3.66
2. Informing activity Jigsaw cooperative learning model to polyfunctional compounds topic	4	3	4	3.66
Main Activity				
A. Mastery Learning Materials				
1. 1. Adjusting the material with the aim of learning	4	4	4	3.66

Observation aspects	O1	O2	O3	Average
2. 2. Linking material with other knowledge	3	3	4	3.66
3. 3. Presenting material in a proper discussion	4	4	4	4
4. 4. Presenting the material in a systematic	3	4	4	3.66
B. Implementation of educated learning strategies				
1. Conduct the learning process according to competences will be achieved	4 3	4 3	4 4	4 3.33
2. Facilitate student activity with multi learning resources	3	4	4	3.66
3. Conduct the learning process harmony	4	4	4	4
4. Comprehending class management	4	3	4	3.66
5. Conduct the learning process to grow positive habituation possibly				
C. Implementation of Jigsaw Cooperative Learning				
1. Presenting information of polyfunctional matter	3	3	4	3.33
2. Organizing students in group of Jigsaw cooperative Learning	3	4	4	3.66
3. Guiding students in work and learning	4	4	4	4
4. Doing evaluation and presenting result of working in group	3	4	3	3.33
5. Giving reward	3	3	1	2.33
D. Use of source Learning / Media in Learning process				
1. Demonstrate skill in the use of learning resources	3	4	4	3.66
2. Demonstrate skill in the use of instructional media	3	4	4	3.66
3. Produce compelling message	4	4	3	3.66
4. Involving students in the use of learning resources	4	4	4	4
5. Involving students in the use of instructional media	4	4	3	3.66
Closing				
1. Making reflection by involving students	4	4	1	3.0
2. Provide follow-up to the next activity	3	4	3	3.33
Number of average score				**94.22**
Total average score	**3.49**			

Based on Table 2 shows that the learning process in the Organic Chemistry 2 course, especially on polyfunctional material using Jigsaw cooperative learning model can be implemented well, with score in range of 3.33 to 4 in the good and very good category. Overall aspect assessed get score 3.49 in the excellent category. The using of instructional media sources and get a score between 3.66 to 4 of all aspects on good and very good category. With the implementation of learning outcomes are included in the criteria of good and very good it will be seen also student learning outcomes by providing a test on the material polyfunctional compounds. Observation of student activity in the classroom of Organic Chemistry 2 course with Jigsaw cooperative learning model supported as shown at Figure 1.

Figure 1 Students are in groups: (A) original group (Group 7),
(B) The expert group material D: phenolic acids

In addition, we can observe the activities of students in a group discussion and use of learning resources supported by Figure 2.

Figure 2 (A) Students interaction in Jigsaw cooperative learning groups
(B) Interaction of students with learning resources (student book, gadgets for browsing teaching material)

Figure 3 Presentation of group work by students and clarification from lecturer

Figure 3 presents the student activities in the final stage of cooperative learning by presenting the results of the group discussions that have been finalized in the original group. In this activity lecturer as a facilitator will be clarify anything if needed to help straighten out the answer when the students presenting their work. In this study the end of the lesson according to the syntax of cooperative learning should no awards. However, the syntax does not look real by giving something to a student or group of students, but only as a compliment of verbal praise of lecturers as reinforcement on the performance of students either individually or in groups. This led to a score of adherence to cooperative learning as in Table 1 section C.5 get a score just 2.33, in quite well category.

After completion of learning in the classroom for Organic Chemistry 2 course on material of polyfunctional compounds that requires two meetings, than conducted the test. The results of the test on polyfunctional compounds material in Organic Chemistry 2 can be seen in Table 3.

Table 3 Results of test material with a polyfunctional compound Jigsaw cooperative learning using a variety of learning resources.

Letter	Score	Interval	Students	percent
A	4.0	85≤ A ≤100	2	3.7%
A^-	3.75	80≤ A^- ≤85	5	9.2%
B^+	3.5	75≤ B^+ ≤80	20	37.1%
B	3.0	70≤ B ≤75	13	24.1%
B^-	2.75	65 ≤ B^- ≤70	9	16.7%
C^+	2.5	60 ≤ C^+ ≤65	4	7.4%
C	2.0	55 ≤ C ≤60	0	0
D	1.0	40 ≤ D ≤ 55	1	1.8%
E	0	0 ≤ E ≤40	0	0

Based on Table 2 . Learning outcomes of students in the category of A^- and A grades at 12.9 % ; B^- to B^+ 77.9 % ; grade of C^+ 7.4 % in completed category and D 1.8 % ; as well as E 0 % in the incompleted category . Based on these data of classical mastery learning had been achieved greater than 80 % it is 90.8 %.

Student response to this study shows student data was pleased with the material 9.1 %; like in the learning process 66.7 %; and 21.2 % interest to the learning media/ learning resources. Based on these data the dominant student was pleased with varying learning process, through group discussions on the Jigsaw cooperative learning model type. Based on the result of students interviews they feel happy because they feel more energized and motivated to learn the material organic chemistry 2 by utilizing information technology as a learning resource. It is like Margareta (2014) statement that we do not make the technology as so rival, so as friends to make we no stop learning" [9]. In addition, learning becomes monotonous tasks can quickly respond and get clarification. Thus from this study an increase in the learning process with more activating and expanding student learning resources from a variety of sources was occurred.

CONCLUSSION AND SUGGESTION

The result of this study can be concluded that: 1)The implementation of Jigsaw cooperative learning Model of all components of the average of the 3 observers get a score of 3.49 in good categories; 2) Almost all stages of Jigsaw Cooperative learning get score between 3.33 to 4.00 on good and very good category, except the award given syntax obtain an average score of 2.33 in quite well category; 3) Learning resources and media usage get score between 3.66 to 4.00 on very good category. 4) The student learning outcome in polyfunctional compound topic with the details value of A^- to A 12.9 % ; B^- to B^+ 77.9%; and C^+ 7.4% on mastery learning category; as well as D 1,8% and E 0% on not mastery learning category. 5)The students response about this learning, they interest on the matter 9.1%; learning process 66.7%; and learning resources 21.2%.

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