2Sharing and Jumping Task Learning Design of Empirical and Molecular Formula Concept

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Abstract: Instructional process is a sharing activity which students learn from each other. Learning activities involve different students’ abilities. Therefore, the design of learning activities using two types of activities, which are a sharing activity (sharing task) with have same level of textbooks and must be understood by all students, and jumping activity (jumping task) that exceeds the level of textbooks. The lack of didactic anticipation is reflected in instructional planning that why students’ learning obstacle appears. The aim of this study is to produce an instructional design of sharing and jumping task to prevent students’ learning obstacle on Empirical Formula and Molecular Formula concept. Subject of this study is 57 students of X IPA 1 and 2 in Laboratorium UPI High School. We apply descriptive qualitative method. We collected data through TKR (Tes Kemampuan Responden), observation sheets, interview guideline. We implemented the lesson design twice in different group of students. The result of first implementation, in sharing task activity students were not active in the group discussions so that there are still learning obstacles appear. However, in jumping task activity, students become more active in discussion because the students are faced with a new situation of challenging problems, although they still need help from teacher. Revision of instructional design is implemented on second class. In second implementation, group discussions on sharing task activity is more active so it can minimize students’ learning obstacle, although still need help from teachers. But in jumping task activity, there are still many students who can’t catch the concept and they still need help from teacher. Based on the results of both these implementations, we obtained an tried out instructional design of sharing and jumping tasks that provide good advantages for students who have high or low ability.

Keywords: Learning Design, Sharing and Jumping Task, Empirical and Molecular Formula.

1. INTRODUCTION

Education is a major factor in the formation of character and quality human resources. Moreover, the success of a country can be measured by successfulness of country in education to create intellectual people. Recognizing this, the government is very serious about dealing with the education system, because with a good education system can produce generation which qualified and able to adapt to living in a society, nation and state. The seriousness of the government in improving the education system is also demonstrated by the development of the curriculum from year to year.

Curriculum development undertaken by the government is based due to low student achievement. It can be seen from the results of TIMMS (Trends in Mathematics and Science Study), which is one of the international assessment which aims to see the content and the thinking of students in mathematics and natural science. Based on data from TIMSS in 2011, Indonesia was ranked 40th out of 42 countries. Indonesian student achievement is on a scale of Low namely students were only able to identify a number of basic facts but have not been able to communicate and linking various science topics, can’t be able to implement complex and abstract topics. The low of Indonesian students achievement in science, indicates the ineffectiveness of the learning process that occurs.

Collaborative learning is learning which is based based on Vygotsky's theory of social constructivism. The theory of social constructivism is known as the Zone of Proximal Development (ZPD). ZPD Vygotsky’s theory refers to the attainment of knowledge is done by providing scaffolding, scaffolding offered to the students not to be done by teachers, but can be done by peers who have higher academic ability. Scaffolding that given by teachers in the form of questions, directives, and instructions to guide the students achieve understanding of the concept. While scaffolding from peers are working together to accomplish a task that is done through discussions. Wiersema (2000) states that collaborative
learning is philosophy: working together, building together, learning together, changing together, improving together. While collaborative learning by Sato (2014) is a study carried out in the group, which aims to encourage students in the group to find a variety of opinions or thoughts incurred by each individual in the group. In collaborative learning occurs studying the relationship between students who have high academic ability with students who have low academic ability.

The learning process does not happen in the unity, but the learning is the result of diversity or difference. In learning activities involve the ability of the diverse students' understanding and therefore teachers design lessons using two types of topics, sharing ask is the individual tasks through collaborative small group that contains the basic materials in the level textbooks and to be understood by all students, and jumping task is a problem that given to increase (jump) higher student ability. Problems in the jumping task contains basic materials have been developed (beyond the level of a textbook) is the material application of the basic concepts. (Sato, 2014). On learning task sharing and jumping can benefit all students both students who have low cognitive abilities or students with students who have higher cognitive abilities. In this study not only increase students' cognitive abilities but also improve students' affective and psychomotor.

Chemistry concept in this research is empirical formula and the molecular formula concept which is an abstract concept that is the principle. Based on the results of several studies on the topic of empirical and molecular formula and students’ understanding of the empirical formula and the molecular formula, it was found that the students had some barriers to learning in understanding this concept. Based on research of Nassiff Peter and Wendy A. Czerwinski (2014) shows that students learn to do calculations in accordance with the directives empirical formulas or calculations existing instructions without getting a deeper understanding about the concept. For example, when solving the problem of the empirical formula, students share the divide (or mass percentage) of each element of the molar mass with the lowest number of moles to find the ratio of the element, and then find the smallest ratio of the total. While this approach will lead to the right answer, but students do not understand in depth what they are doing and understanding the underlying chemical concept.

This study investigate how the design of collaborative learning sharing task and jumping task on the topic of empirical formula and molecular formula can overcome students’ learning obstacle. Based on this, the research question are:

a. How is characteristic of students’ learning obstacles that is identified in learning empirical formula and molecular formula concept?

b. How is the design of collaborative learning sharing task and jumping tasks in the topic of empirical formula and molecular formula concept?

c. Is the implementation of collaborative learning design of sharing task and jumping tasks can overcome students’ learning obstacles in empirical formula and molecular formula concept?

2. RESEARCH METHODOLOGY

This study reviews about learning process, student activities during learning process, and the students’ learning obstacles in learning chemistry concept. However, the focus of this research is to develop a didactic design based on students learning obstacles so that produce learning design which is expected to develop into a better direction. Participants in this study are teachers and students. Participant of students in this study consist of three groups. First participants are second semester students in grade IX which is the participant who have learned empirical formula dan molecular formula concept to identify students’ learning obstacle in this concept. The second participant is a student in grade X who will be taught about empirical formula and molecular formula concept based on first collaborative learning design which have been designed. The third participant is the students in grade X who will be taught about empirical formulas and molecular formulas concept based on first collaborative learning design revision from first implementastion which has been designed according to the lesson analysis and teacher’ self-reflection. Collaborative learning design is implemented in twice with the same concept of chemistry but different group of class.

Research design that used in this study is didactical design reserach. According to Suryadi (2013) studies the didactic design basically consists of three stages:

1) prospective analysis
2) analysis metapedadidaktik
3) retrospective analysis

181
The instrument which are used is TKR (Tes Kemampuan Responden), observation sheets, interview guideline. TKR and interview guidelines are used to identify students’ learning obstacle before designing the lesson and to determine whether students’ learning obstacles can be solved or minimized, while the observation sheet is used to analyze the implementation of collaborative learning in both classes. TKR consists of 3 questions which is tested to 15 students in grade XI who has been studying about empirical formula and molecular formula for identifying students’ learning obstacles on this concept before designing collaborative learning sharing task and jumping task. TKR is also tested to class X after implementing collaborative learning sharing task and jumping task.

3. FINDING AND DISCUSSION

In preparing a lesson design is required an identification of students’ learning obstacle in the concept of empirical formula and molecular formula. Students’ learning obstacle is derived from the analysis of the results students’ answers in TKR and reinforced by the results of interviews with some of the students who have done the test. Based on the results of the initial TKR and interview of students are obtained students’ learning obstacles in the concept of empirical formula and the molecular formula are:

1) Students do not understand the meaning of the empirical formula and the molecular formula
2) Students do not understand the meaning of mass percentage
3) Students are not able to determine the simplest ratio of mole from each element
4) Students do not understand the meaning of relative atomic mass (Ar) with relative molecular mass (Mr)

Brosseau (2002) states that the error is not only a result of ignorance, uncertainty, chance but the effects of previous knowledge interesting and true, but which is now declared as wrong knowledge or can not be accepted easily. Errors of this type of uncertainty and unpredictable, it is called learning obstacle. Learning obstacle occurs naturally by students in learning process.

Students’ learning obstacles that have been identified through the initial TKR and supported by interviews of students that became basis to design a lesson design which can minimize students’ learning obstacles. Learning design consists of Chapter Design and Lesson Design. In Chapter Design consist of essential concepts, time allocation, way of learning, learning objectives, skills are developed, and how to evaluate (Fitriani 2015). Learning method that used to build concept of empirical formula and the molecular formula is group discussion. Students were divided into eight groups, each group consist students who have high, medium and low ability. The group division is based on the level of student's ability so that discussion can be run well and students can learn from each other (sharing konwledge).

Lesson Design is a detail of steps from chapter design and anticipation that is prepared to face prediction of students’ responses that may occur in learning process which aims to minimize students’ learning obstacles. According to Vygotsky that a good learning environment can help students to achieve their potential abilities. In lesson design consists of three activities, initial activity (apperception), the core activity (sharing activity) and the closing activity (jumping activity). At the core activity consists of sharing task activities that facilitate students in developing potential development while in the closing activity is jumping task activity.
In apperception, teacher pose questions to the students about the compounds that exist in coffee. Prediction of students’ responses is students can answer caffeine as a compound that exist in coffee. Students are given activity to observe atoms which form caffeine as well as the number of atoms of each element. In core activity, students are watching video experiment about combustion of magnesium to determine the empirical formula and the molecular formula. Activity that given in the core activity is students practice to determine the empirical formula and the molecular formula in students’ worksheet that has been provided through discussion group. These core activities are is called "sharing” activity because it occurs inter-group cooperation to solve the problems, the interaction occurs in stating opinions or ideas. Students’ worksheet consists of two questions that correspond to the level of the textbooks that must be understood by all students. In the closing activity is ”jumping” activity. At this activity, students are given the problems which level of difficulty is beyond textbooks and about application of concepts in daily life. Problems that given in jumping activity is determine the molecular formulas of the combustion of Vitamin C.

After first implementation of collaborative learning design of sharing task and jumping task in empirical formula and the molecular formula concept is conducted TKR 1. Based on analysis of student answers, there are still students’ learning obstacle are identified, it is obtained from students’ answers which still made mistakes in answer the questions of TKR. But students’ learning obstacles are already minimized. The following table distribution of students' ability to solve problems on the material TKR empirical formula and molecular formula. The percentage is to see how high students’ learning obstacles in answering questions of TKR.

Tabel 1. Distribution of Students’ Achievement in TKR I

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount of Students (n = 27)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Test</td>
<td>Score 0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>%</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>%</td>
<td>4,81</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>%</td>
<td>0</td>
</tr>
</tbody>
</table>

Based on the table above, the percentage illustrate students’ learning obstacles in empirical formula and the molecular formula is already minimized. It shows from the number of students who answered questions correctly. Obtaining the greatest percentage in question number 1 is 49.74% with a score of 30 that indicates almost all the students were able to answer the empirical formula and the molecular formula of the compound by answering the calculation stage correctly. In question number 2, gain the highest score at 30 which is the highest score with a percentage of 37.03%. Then in question number 3, the highest percentage gain in highest score of 35, which is about 48.15%.

In question number 1 is still found some students who get obstacle to interpret the percentage of mass from each element in a compound. Students also get difficulties in calculating the value of n so that students are not able to determine the molecular formula of the compound, it is seen at the students’ answers which get obstacle errors in determining the value of n. This is because students' difficulties in mathematical calculations. In question number 2 found student who get error in writing order of elements in the formation of compounds but almost all students can determine the empirical formula and the molecular formula of the compound by performing the steps necessary. It is also found students’ mistake who do not calculate the ratio of mole in determining the empirical formula and the molecular formula. Students’ mistake that identified in question number 3 same as in question number 1, there are students who do not understand the meaning of mass percentage. Overall students’ learning obstacle in
the concept of empirical formula and molecular formula can be minimized. It can be seen from the reduction of mistakes that made by the students at TKR 1.

The results of teachers’ self-reflection from lesson analysis and teachers’ interviews are used to revise the design of collaborative learning design of sharing task and jumping task in the first implementation. The learning process needs to be improved for future learning process is more concerned in time allocation so learning objectives can be achieved, teachers were more responsive in anticipating in variety of student responses that appear beyond prediction, reduce teachers’ involvement in group activities. Revision of collaborative learning design of sharing task and jumping task is implemented on second class. After first implementation of collaborative learning design of sharing task and jumping task in empirical formula and the molecular formula concept is conducted TKR 2.

<table>
<thead>
<tr>
<th>Items Test</th>
<th>Amount of Students (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Score 0</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>%</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>%</td>
<td>16,67</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>%</td>
<td>3,33</td>
</tr>
</tbody>
</table>

Tabel 2. Distribution of Students’ Achievement in TKR 2

Based on the table above, the highest percentage gain in question number 1 is 36.67% with score of 30. In question number 2, gain the highest score of 25 with a percentage about 56.67%. Question number 3 gain the highest percentage on a score of 30, which about 53.33%. In question number 1 is still found some students who get obstacle in calculating the mole ratio. This is because students' difficulties in mathematical calculations. In question number 2 found a mistake in calculating the relative molecular mass. While there is no obstacle that identified on question number 3.

Students’ learning obstacle in concept of empirical formula and molecular formula can be minimized. It can be seen from the reduction of mistakes made by students in the TKR in first implementation and second implementation. There four types of students’ learning obstacles in first implementation, while there is only two types of students learning obstacles.

4. CONCLUSION

Conclusion of this research is that collaborative learning design of sharing task and jumping task can minimize students’ learning obstacle in concept of empirical and molecular formula. There four types of students’ learning obstacles in first implementation, while there is only two types of students learning obstacles. Collaborative learning design of sharing task and jumping task give students opportunity to build concept by themselves through group discussion, by pose scaffolding students can develop their ability from actual development to the potential development.

5. REFERENCES


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