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DESCRIPTION OF THE CONCEPTUAL CHANGES IN CHEMICAL PRE-SERVICE TEACHERS IN UNIVERSITY OF TANJUNG PURA USING LEARNING 5E CYCLE MODEL ON REACTION RATE MATERIALS

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ABSTRACT

The aim of this study was to describe conceptual change of student before and after being taught through 5E learning cycle on rate of reaction. One group pretest-posttest design was chosen as research design. Population consists of three classes students on academic year of 2016/2017. According saturation sampling technique, all of population then was chosen as samples. CRI Aided Achievement test was utilized to collect data about students' conceptual change. The result showed that conceptual shift was successfully confirmed. It was described according to five objectives. They were 1) objective of determining of the order of reaction which students gained 18.75 % improvement; 2) objective of determining the rate law which students gained 46.88 % improvement; 3) objective of determining the rate constant which students gained 15.62 % improvement; 4) objectives of determining the rate of a reaction which students gained 9.37 % improvement; and 5) objectives of determining the half-life which students gained 62.50 % improvement

Keywords: ***5E learning cycle, conceptual change, rate of reaction.***

Introduction

Chemistry learning is still often found in students 'misconceptions, which is caused by students' difficulties in understanding the concept. According to Effendy (2002) most students have difficulty in understanding chemical concepts and principles. Chemical concept errors experienced by students are also experienced by students of the Chemistry Education and Teaching and Education Faculty of Tanjungpura University (FKIP UNTAN) who are candidates for chemistry teachers.

Test results for questions in 15 students the second semester of the Chemistry Education Study Program FKIP UNTAN 2015/2016 Academic Year obtained several forms of student misconceptions after working on the problem at the reaction rate. The forms of conceptual errors include: 1) in determining the reaction order students do not change the time from seconds (t) to the reaction rate (1 / t), mistakenly read the experimental data and do not add the order obtained by each reagent; 2) in determining the reaction rate with an increase in temperature of 10oC from the beginning, students are wrong in using the formula; 3) in determining the reaction rate equation, students incorrectly write the reaction rate equation and think that the reaction rate equation is the reaction rate constant (k). Based on the above errors it can be said that the understanding of the student's concept of the reaction rate material, especially in order determination and reaction rate equations is still not intact.

If the student's conceptual errors in the reaction rate material are not overcome, it can have an impact on the difficulty of the student in understanding the following related concepts, especially in the subject of Physical Chemistry I and II in the following semester. According to Nakhleh (1992) the difficulty in learning chemistry was due to chemical material that was interrelated with each other. If identified students experience a conceptual misconception in chemical matter, it will inhibit them from connecting between concepts with one another. Before participating in the formal learning process in school students have brought the initial concepts of everyday life, the concepts brought by students are sometimes not in accordance with scientific concepts conveyed by experts so that it can lead to misconceptions (Suparno, 2013). These conceptual errors can be overcome by providing a good and complete understanding of concepts in chemistry learning.

Chemistry learning is expected to be able to provide a good and complete understanding of concepts to students, one of them through a constructivist approach. According to Prawiradilaga (2009) constructivism prepares students to form their own understanding and mindset. Some learning strategies with constructivist approaches can be used in chemical learning, one of which is the learning cycle / LC 5E model. The learning cycle model consists of five learning phases which include: Engagement, Exploration, Explanation, Elaboration, and Evaluation (Lorsbach, 2002). Students can identify a pattern of regularity in the phenomena investigated through the 5E learning cycle model, then introduce concepts that have to do with the phenomena that are investigated and discuss them in the context of what has been observed, then use concepts that have been introduced to new situations.

The learning cycle is a research-based learning model that can help students explore concepts in science and help educators as they plan lessons intended to facilitate meaningful and indepth understanding of the concepts being taught (Duran, Duran, Haney, & Scheuermann, 2011). Based on the explanation above, it is necessary to do research on the implementation of the 5E learning cycle model in the rate of reaction material towards the conceptual change of prospective chemistry teachers at Tanjungpura University. This study aims to describe the conceptual changes experienced by prospective chemistry teachers at Tanjungpura University after being taught using the 5E learning cycle model in the reaction rate material.

Research Method

The form of this research is praexperiment design with the design used in this study is One Group Pretest-Postest Design with the following pattern (Prabowo, 2011):

U1 L U2

U1= Pretest.
L = Treatment of applying the learning cycle 5E model.
U2= Posttest.

The population in this study was the first semester students of the Tanjungpura University Chemical Education study program 2016/2017 Academic Year consisting of 3 classes with sample selection techniques carried out by saturated sampling.

The independent variable in this study is learning before and after using the 5E learning cycle model. The variable in this study is the conceptual change of students. The data collection technique used in this study is measurement. The instrument used in this study is a learning outcome test in the form of reasoned multiple choice tests with cognitive levels ranging from C3 (applying) to C5 (evaluating). Tests of learning outcomes are answered by including a level of confidence based on the Certainty of Response Index (CRI) scale that can detect possible student misconceptions (Table 1).

TabLE 1. CRI scale interpretation in the test

CRI Scale	Criteria
0	*Totally guessed answer*
1	*Almost guess*
2	*Not sure*
3	*Sure*
4	*Almost certain*
5	*Certain*

(Hasan dkk, 1999)

Student conceptual changes are seen based on the level of understanding of student concepts at the pretest and posttest on each indicator. These conceptual changes are grouped into eight groups based on the level of understanding of student concepts (Table 2). The percentage of students in each conceptual change category is determined by the following formula, adopted from Thoha (2003):

$$M = \frac{\sum X}{N} \times 100\%$$

$\sum X$ = Number of Students
N = Number of Test.

Tabel 2. Level of understanding of student concepts

Choice of Answer	Reasons	CRI Score	Description
True	True	>2,5	Mastering the concept well
True	True	<2,5	Mastering the concept but not confident with the answers given
True	False	>2,5	Misconception
True	False	<2,5	Misunderstanding

Choice of Answer	Reasons	CRI Score	Description
False	True	>2,5	Misconception
False	True	<2,5	Misunderstanding
False	False	>2,5	Misconception
False	False	<2,5	Misundertanding

Diadopsi dari Hakim & Kadarohma (2012)

Results and Discussion

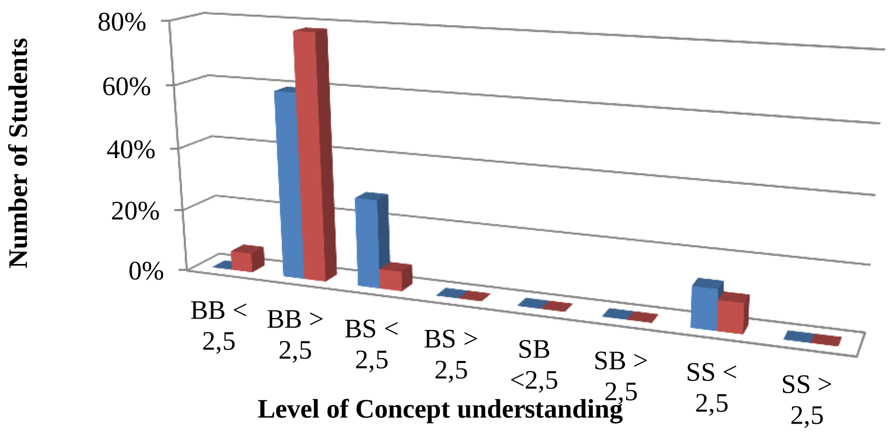
Description of the conceptual change of the Tanjungpura University

The Description of Conceptual Changing

Chemical Education Study Program students after being taught to use the 5E learning cycle model in the material reaction rate for each indicator can be described as follows:

The indicator of determines the reaction order.

Student conceptual changes in the indicator determine the order of re- action can be seen in Figure 1.

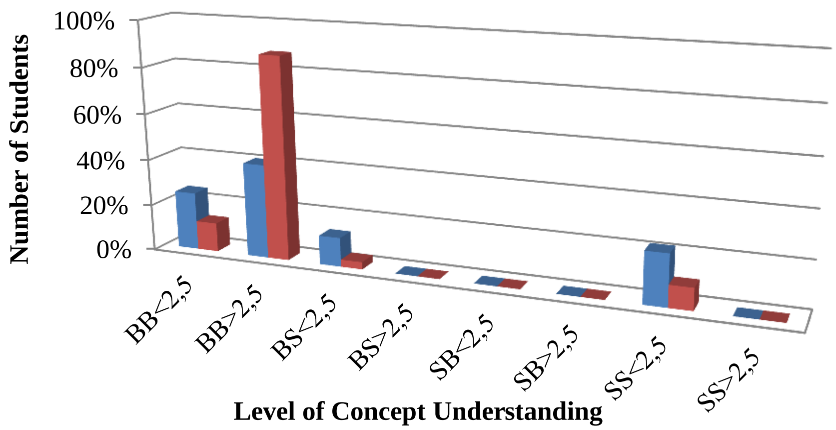


	BB < 2,5	BB > 2,5	BS < 2,5	BS > 2,5	SB <2,5	SB > 2,5	SS < 2,5	SS > 2,5
Pretest	0%	59,37%	28,12%	0%	0%	0%	12,50%	0
Posttest	6,25%	78,12%	6,25%	0%	0%	0%	9,30%	0

Figure 1. Conceptual changes in students in determining the reaction order.

BB = Correct Answers, Correct Reasons
BS= Right Answer, Wrong Reason
SB= Wrong Answers, Correct Reasons
SS= Wrong Answer, Correct Reason

In the correct answer the correct reason with CRI <2.5 indicates that students master the concept but do not have confidence to increase by 6.25%. The correct answer for the right reason with CRI> 2.5 shows that students master the concept well, increasing by 18.75%. The correct answer for the wrong reason with CRI <2.5 indicates that students do not know the concept has decreased by 21.87%. The wrong answer to the reason was wrong with CRI <2.5 indicating that students did not know the concept had decreased by 3.2%.



	BB<2,5	BB>2,5	BS<2,5	BS>2,5	SB<2,5	SB>2,5	SS<2,5	SS>2,5
Pretest	25%	40,62%	12,50%	0%	0%	0%	21,87%	0%
Posttest	12,50%	87,50%	3,12%	0%	0%	0%	9%	0%

Figure 2. Conceptual changes in students in determining the law of rate

BB = Correct Answers, Correct Reasons
BS= Right Answer, Wrong Reason
SB= Wrong Answers, Correct Reasons
SS= Wrong Answer, Correct Reason

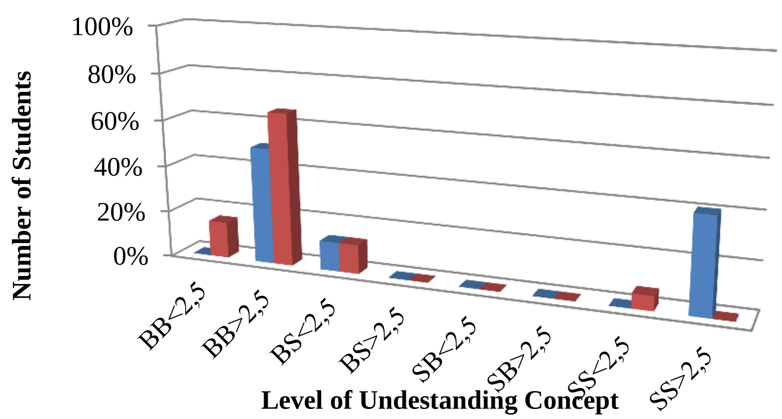
The Indicators of determine the rate law

Student conceptual changes in indicators determine the rate law can be seen in Figure 2.

In the correct answer the correct reason with CRI<2.5 indicates that students master the concept but are not confident with the answer decreasing by 12.50%. The correct answer for the right reason with CRI>2.5, shows that students can master the concept well, increasing by 46.88%. The correct answer for the wrong reason with CRI<2.5 indicates that students do not know the concept has decreased by 9.38%. The wrong answer to the reason is wrong with CRI <2.5 indicating that students do not know the concept has decreased by 12.87%.

The indicator of calculates the reaction rate constant

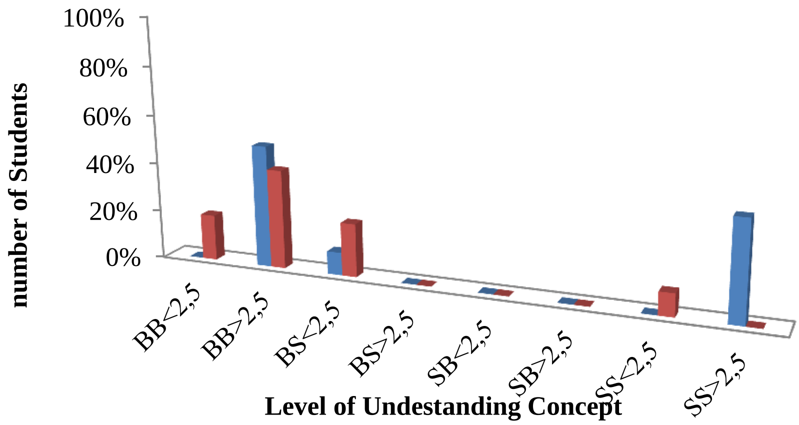
Student conceptual changes in the indicator calculating the rate constant can be seen in Figure 3.



	BB<2,5	BB>2,5	BS<2,5	BS>2,5	SB<2,5	SB>2,5	SS<2,5	SS>2,5
pretest	0%	50%	12,50%	0%	0%	0%	0%	40,62%
posttest	15,62%	65,62%	12,50%	0%	0%	0%	6,25%	0

Figure 3. Student conceptual changes in calculating rate constants

BB = Correct Answers, Correct Reasons
BS= Right Answer, Wrong Reason
SB= Wrong Answers, Correct Reasons
SS= Wrong Answer, Correct Reason



	BB<2,5	BB>2,5	BS<2,5	BS>2,5	SB<2,5	SB>2,5	SS<2,5	SS>2,5
Pretest	0%	50%	9,37%	0%	0%	0%	0%	40,62%
Posttest	18,75%	40,62%	21,87%	0%	0%	0%	9,37%	0

Figure 4. Conceptual changes in students in calculating reaction rates.

BB = Correct Answers, Correct Reasons
BS= Right Answer, Wrong Reason
SB= Wrong Answers, Correct Reasons
SS= Wrong Answer, Correct Reason

In the correct answer the correct reason with CRI<2.5 indicates that students understand the concept but are not confident with the answers given having increased by 15.62%. The correct answer is the correct reason with CRI>2, \5 indicating that students can master the concept well, increasing by 15.62%. The correct answer is the wrong reason with CRI<2.5 indicating that students do not know the concept have not changed at 12.50%. The wrong answer to the reason is wrong with CRI <2.5 indicating that students who do not know the concept have increased by 6.25%, but this was followed by a decrease in students who experienced misconceptions at the pretest of 40.62%.

The indicator of calculates the reaction rate

Student conceptual changes in the indicator calculating the rate constant can be seen in Figure 4.

In the category of correct answers the reasons are wrong with CRI<2,5 indicating students do not know the concept has increased by 50%. The wrong answer reasoning category with CRI<2.5 indicates that students do not know the concept increased by 37.5%, but in the wrong answer wrong reasons category with CRI>2.5 decreased by 87.5% indicating student misconception after learning using the model 5E learning cycle in the material the reaction rate decreases.

he increase in student conceptual changes at a better level of understanding of concepts is caused by the application of learning using the 5E learning cycle model to the reaction rate material. The engagement phase can uncover student conceptions through questions from phenomena found in everyday life in accordance with the concept of reaction rates. In this phase students experience assimilation using existing cognitive structures to respond to new information they receive, so as to reduce the cognitive imbalances that occur.

The next phase (exploration) of students explores ideas to introduce and discuss concepts with the help of student worksheets (MFIs). The concepts that have just been accepted by the students are not all able to be assimilated into the scheme that they already have, which ultimately results in the accommodation process. The balance process is needed to adjust the balance between the assimilation process and accommodation. Piaget states that knowledge is not static, but continues to develop and change constantly as long as students construct new experiences that compel them to build and modify prior knowledge (Arends, 2008).

The explanation phase encourages students to explain the understanding of the concepts they have obtained. This phase is expected to reduce the conceptual errors that occur and students can get a complete understanding of the concept. The elaboration phase facilitates the transfer of concepts for the same situation but is new with the help of advanced MFIs. Students carry out advanced practicums in accordance with the advanced MFI provided to develop deeper and broader understanding of concepts. Cooperative learning situations can provide opportunities for students to express their understanding of the material being studied. Learning becomes more meaningful because students are able to connect new situations and problems with existing cognitive structures. According to Ausabel the meaning can arise from new material only if the material is related to the cognitive structure of previous learning(Arends, 2008). The last phase in the learning cycle model is evaluation which is an opportunity for teachers to assess students' conceptual understanding.

Conclusion

Conclusion in this study is the application of learning using the 5E learning cycle model in the reaction rate material causing an increase in student conceptual changes at a better level of understanding of concepts. Based on the obstacles found in the research, suggestions were given as alternative solutions, namely: giving more attention and guidance to students in the exploration phase and elaboration phase, so that the time needed for these two phases can be utilized effectively. In this phase it takes longer time for students to do practicum in accordance with student worksheets (LKM) and actively build concepts independently (exploration phase) and develop deeper and broader understanding of concepts in the same but new situations (elaboration phase).

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