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The Effectiveness of Problem Based Learning Model Through Providing Generic Science Skill in Organic Chemistry Reaction Subject

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Abstract. Problem Based Learning is one of the teaching models that require students to be active, collaborative, student-centered, develop their problem-solving skills, and independent learning. This study was aimed at investigating the effectiveness of the problem-based learning model by providing generic chemistry skills (MPBM-PKGK) in organic chemistry reaction subjects as well as finding out students' responses to the application of the developed model. The subject of this study was students of the chemistry education study program who took organic chemistry reaction subject. It was divided into two groups, one of them was the experimental group, taught by using a problem-based learning model through providing generic chemistry skills while the other was the control group, taught by using the direct instruction model. The data were obtained by using a pre-test, post-test, and questionnaire. The results showed that the increase in the generic chemistry abilities of students using MPBM-PKGK was higher than the direct instruction model, meaning that MPBM-PKGK was effectively used in improving mastery of the concept of organic chemical reactions. While the students' responses on the application of MPBM-PKGK agreed and content to the developed model. It was shown from the attention aspect, adding concept, students' involvement in the teaching-learning process, students' thinking skills as well as expected that the MPBM-PKGK model can be used continually.

1 Introduction

Organic chemistry is chemistry that comes from living bodies, where most of it consists of the same elements, among others; carbon, hydrogen, oxygen, nitrogen and sometimes sulfur, phosphorus and others. Because carbon is always present in organic compounds, organic chemistry is defined as a chemical compound self-contained in carbon [4] Based on the observation of chemistry lecturing on organic chemistry 1 and 2 subjects in the last three years, the result showed that there were many students could not understand the concept of organic chemistry. It was found from the students' average score that was 70 and it showed that only 15% of the students got A and so did the practicum, especially on organic chemistry reactions which was below the expectation as well as some materials couldn't be conducted caused by the limited times and facilities in the laboratory. The reality showed that chemistry teacher in several high school stated that organic chemistry subject which learned by teacher candidate in teacher training center these days were less provide them with how to teach senior

high school students the organic chemistry subject. It is supported by the interview and questionnaire results from several teachers who stated that it is quite hard to determine types of organic chemistry reactions found in senior high school Olympics questions. The concepts of organic chemistry were considered as hard to understand particularly on the types of reactions, reaction mechanism and organic synthetic. The students considered it as an abstract object which is hard to understand [2].

Problem Based Learning (PBL) model is one of the ways method to improve chemistry organic concepts mastery. Problem-based learning is a learning model that involves students in an active, collaborative, student-centered learning process, developing problem-solving abilities and independent learning abilities. Problem-based learning shows student involvement in learning through authentic experiences that are reflected in a student-centered chemistry curriculum [6]. Problem-based learning promotes high-level questions and stimulates student thinking, thus playing an important role in preparing students to face real world challenges [8] . PBL is an educational method where students develop their thinking and problem solving skills besides developing their understanding about key concepts through problem analysis in the real world [7]. One of the approaches where students experience and discover the knowledge themselves is called PBL. In PBL, small group consists of 6 or 8 students with a tutor is made. The authentic and complex problem are given to help students to relate between theory and its application in reality, as well as developing their skills to overcome the complexity of reality [9]. This model is felt right because generic abilities will emerge if it is supported by a student-centered learning atmosphere, so that students are free to express ideas that arise in themselves and a learning environment that supports students' active role in learning.

Chemistry material and chemistry lecture used to provide the students with generic science skills. Thus, the university is asked to provide students with generic science skills [1]. [10]Generic science skills can be categorized into 9 indicators, they are: (1) direct observation; (2) indirect observation; (3) magnitude scale awareness; (4) symbolic language; (5) logic of obeying the principal framework; (6) logical interference; (7) law of cause and effect; (8) mathematical modelling; (9) concept construction. The application of problem-based learning models can improve students' generic science skills with indicators of direct observation, indirect observation, causal law, logical inference, and a framework of complying with principles. The purpose of this study was to determine the effectiveness of problem-based learning models through provision of generic chemistry skills (MPBM-PKGK) of teacher candidates in organic chemical reactions lectures.

2 Research Methodology

This study was conducted by using "one group pre-test post-test design" with a quasi-experimental method. The subject was teacher candidate students of semester 4 in chemistry education program who took organic chemistry reactions subject at the year of 2018-2019, Universitas Negeri Medan. The students consisted of 2 classes, that experimental class was taught by using MPBM-PKGK while the control class taught by using the direct instruction model. The data was collected by using a multiple-choice test which consisted of 40 questions to measure students' generic chemistry skills which had been validated before by the expert validator. The data were pre-test and a post-test score of experimental and control class which were analyzed by using SPSS version 20. As the requirements in doing data analysis, normality and homogeneity test were done previously. To find out the effectiveness of the learning model developed by MPBM-PKGK, the N-gain value of the experimental class using MPBM-PKGK and N-gain in the control class using the direct instruction learning model is calculated.

Student responses to the MPBM-PKGK that have been implemented are expressed through 13 questionnaire statements and present four aspects, namely concentration of attention, added concepts, active invitation to think student involvement. The questionnaire was modified from the questionnaire by Hartono (2006). The expected student responses include Strongly Disagree (STS), Disagree (TS), Agree (S), Strongly Agree (SS). Furthermore, students' responses to the MPBM-PKGK were analyzed by giving a score to each student's answer with a weight of 1 for strongly disagree (STS), a weight of 2 for disagreeing (TS), a weight of 3 for agreeing (S) and a weight of 4 for strongly agreeing (SS).

3   Results and Discussion

3.1.   The Application of MPBM-PKGK

After conducting prerequisites data analysis testing, namely normality and homogeneity test, the distributed normally and homogeneous data were obtained. Then, the hypothesis testing by using SPSS program version 20 for windows can be done. The improvement of students' generic chemistry skills is shown in Table 1 which consists of the analysis of pre-test and post-test average score, t-test and two-sided test of significance with 95% of reliability o improve generic chemistry skills in which the teacher candidate in experimental class was taught by using MPBM-PKGK while the control class taught by using direct instruction model.

Table 1. Pre-Test and Post-Test Score of All Generic Chemistry Skills

No	Class	Test	Average	SD	t	significant	
1	Experimental	Pretest	35,24	6.01	-43.835	0,000	Ho rejected
		Posttest	85,99	7.50			
2	Control	Pretest	23,804	10.36	-9.325	0,000	Ho rejected
		posttest	51,73	11.54			

In the table above, it can be seen that the significance is <0.05, this means that there is a significant difference between the results of the generic ability test before and after learning, both for the Experimental Class and the Control Class. The highest mean posttest score was 85.99 for the Experimental group and the lowest posttest mean score was 51.73 for the Class Control group. Meanwhile, the highest pretest means score was 35.235 for the experimental group and the lowest pretest mean score was 23.80 for the control class group. Overall, there has been an increase in the generic ability of chemistry for students of the two classes studied. Although the Control Class and the Experimental Class each experienced a significant increase, it is necessary to further analyze how the warnings are and whether there is a significant difference between the two. Therefore% N-Gain of both Classes was compared and tested. The% N-Gain data and its significance test can be seen in Table 2 below.

Table2. Statistical Test Results % N-Gain of Students' Generic Chemical Ability Overall

No	Class	%N-Gain	Category	SD	t	significant	
1	Experimental	78,3	High	11,40	12,09	0,000	Ho rejected
2	Control	36,9	Medium	18.06			Ho rejected

From the table above, you can see that the% N-gain of the Experimental Class is higher than the Control Class. Based on the classification of% N-Gain stated by [5], the% N-Gain Class Experimental is 78.3 which is a high level of achievement while the Control Class is 36.9 which is a moderate level of achievement. Then the research found that learning using problem-based learning models has been able to improve the generic ability of chemistry teacher candidate students compared conventional learning (direct instruction). Based on the table above, it can be described as the mean pretest-posttest and N-gain Class Experimental and Control Figure 1 below.
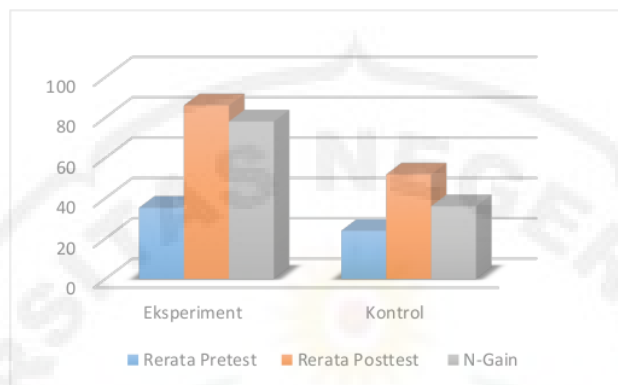
Figure 1. The Average Score of Pretest Posttest and N-gain of Experimental and Control Class

3.2. Student Responses after Implementing MPBM-PKGK

The results of the evaluation of the learning process during the MPBM-PKGK that have been applied, the student's response is obtained as a response to the MPBM-PKGK during the implementation of learning, it can be concluded that overall, on average students are satisfied following this lecture, the highest average score is 3.62 or Among the criteria agree and strongly agree that "Students / Respondents feel satisfied following this lecture" means that students state that the applied learning model has demonstrated mastery of generic abilities and the content of Organic Chemical Reactions. The question points with the lowest mean score of 3.27, the contents of the questionnaire are "Lecture activities of Organic Chemistry Reactions and generic science skills help me in linking between concepts". A score of 3.27 or 81.75% of students agreed with the MPBM-PKGK model that greatly helped students in linking concepts.

Based on the results of this study, the attention aspect received the highest average, namely 3.50. This shows that the MPBM-PKGK model is applied very well to increase student attention in studying organic chemical reaction reactions so that it can improve generic chemical abilities. The added aspect of the concept and the active invitation to think obtained the same score of 3.42, this shows the ability to think related to the mastery of the concept of chemistry teachers' candidate. The student involvement aspect also scored well with an average of 3.44. From all these aspects, it shows that MPBM-PKGK is very well used to improve the generic chemical abilities of prospective teachers. Below is presented table 3 which states student responses to the learning model developed as follows.

Table 3. Student's Response to the PBL Model and Students' Generic Skills

No.	Questions	Mean	M
1	Attending this lecture was very fun for me	3.44	
2	Lecture activities of Organic Chemistry Reactions and generic science abilities are able to increase mutual respect among students	3.45	**3.50**
3	I feel satisfied following this lecture	3.62	
4	The learning model applied can improve my ability to understand Organic Chemical Reactions	3.38	
5	The learning model applied can clearly demonstrate the concept of Organic Chemistry Reactions and the generic skills I need to master	3.40	**3.42**
	The lecture activity on Organic Chemistry Reactions and generic		

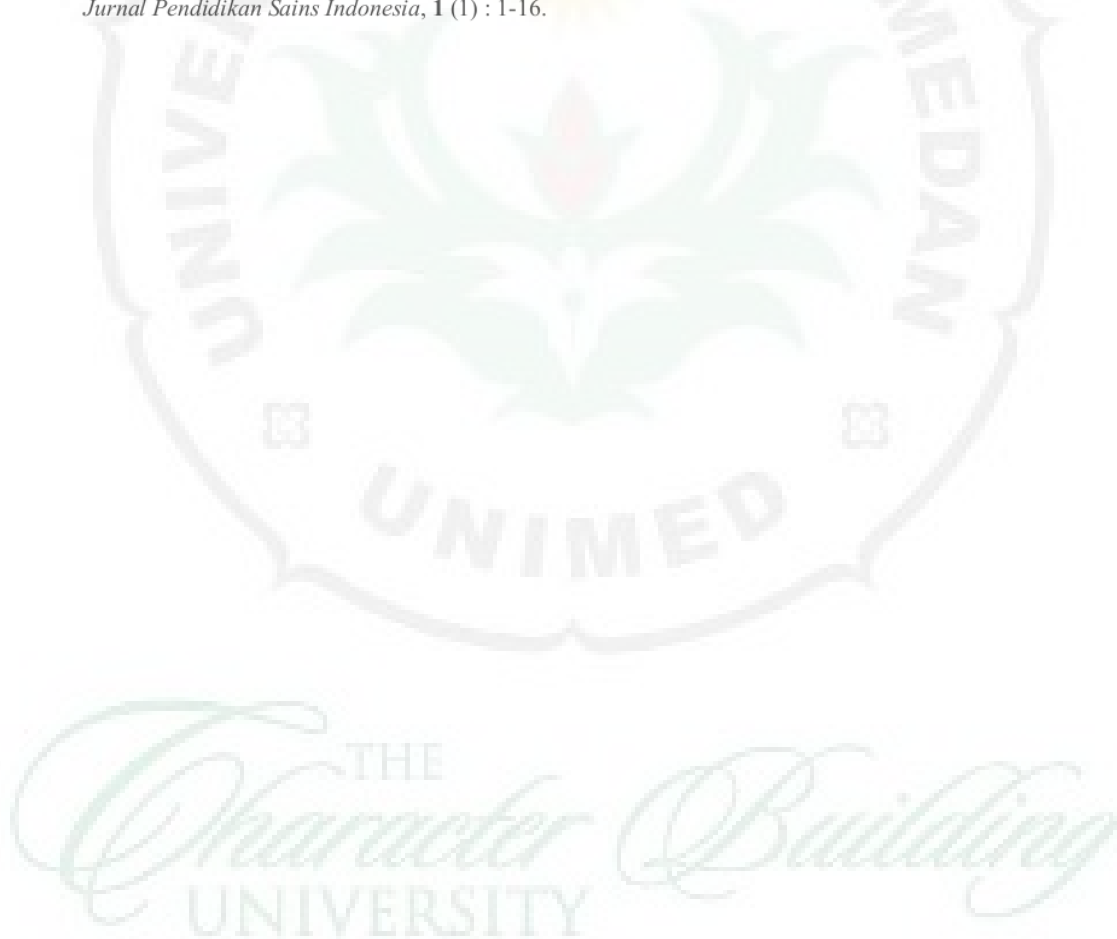| 6 | science skills made me better prepared as a chemistry teacher candidate in mastering the concept of Organic Chemical Reactions | 3.46 | |
7	The lecture activities on Organic Chemistry Reactions encouraged me to improve generic science skills in logical consistency, modeling, symbolic language, abstraction, direct observation, logical inference, understanding of scale, and the law of cause and effect	3.42	
8	The lecture activities on Organic Chemistry Reactions and generic science skills really helped me make connections between concepts	3.27	
9	The lecture activities on Organic Chemistry Reactions and generic science skills encouraged me to be more critical in discovering for myself the concepts, principles, and rules in Organic Chemical Reactions.	3.40	**3.42**
10	Organic Chemistry Reactions and generic science skills activities are encouraged to increase preparation in lectures and practicum activities	3.60	
11	Organic Chemistry Reactions lecture activities and generic science skills were able to increase my courage to answer questions	3.38	
12	Lecture activities of Organic Chemistry Reactions and generic science abilities can increase courage me to ask	3.47	**3.44**
13	Lecture activities Integrated Organic Chemistry Reactions applied generic abilities have made the learning atmosphere more interesting and emphasized student activities	3.47	

4. Conclusion

The problem-based learning model through the provision of generic chemical skills (MPBM-PKGK) is effectively used in organic chemical reactions lectures which is indicated by the% N-Gain value of 78.3 which is included in the high category. The student response to the application of the MPBM-PKGK is very agree and satisfied with the developed model which is shown from the aspects of attention, added concepts, student involvement during the teaching and learning process and improving students' thinking skills and hopes that learning with MPBM-PKGK can be sustainable.

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