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Effectiveness of the pogil model to increase learning motivation and mastery of the concept of buffer solutions students

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ABSTRACT
This research aims to describe the effectiveness of the POGIL model to increase learning motivation and mastery of the concept of buffer solutions students. The research method used is quasi-experimentation with pretest-postest control group design. Sampling is done by random sampling cluster technique and obtained class XI IPA 3 as an experimental class and class XI IPA 4 as a control class. The effectiveness of the POGIL model was analyzed using the n-Gain two-average difference test to learning motivation and mastery of concepts learners' between experimental class and control class. The results of the analysis of the study data showed that the average value of n-Gain motivation learning of learners in the experimental class was greater than the control class, as well as the average grade of n-Gain mastery of concept of the experimental class was greater than the control class. The results of the influence test analysis also showed that increased learning motivation and mastery of the concept of buffer solution students were influenced by the POGIL model. It can be understood that learning with the POGIL model is effective to increase learning motivation and mastery of the concept of buffer solution students.

KEYWORDS
POGIL model; learning motivation; mastery of concept; buffer solution;

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Introduction

Chemistry provides many benefits in life, but facts in the field show that chemistry is considered a difficult science, not interesting to be studied by most students (Halimah, 2016). One of the chemicals that is considered difficult for students is the buffer solution material. Learning difficulties of students on buffer solution materials are found in all concepts (Ambarwati, 2018). This learning difficulty leads to low student motivation.

The motivation of learning students is related to the mastery of concepts owned by students, thus students must have good learning motivation in chemical learning in order to achieve satisfactory results (Hindrasti & Karyanto, 2016). Sufficient motivation when learning something can foster enthusiasm for what is learned and this can bring students to understand more deeply the subject in question (Aeni, 2016). Learning motivation that students have can also determine the success of students in learning (Budiariawan, 2019).

The results of interviews obtained from chemical educators at SMA Negeri 12 Bandarlampung showed that during the chemical learning process educators have given attention that evokes the learning spirit of students, but students feel that the learning activities they participate in have less value for the lives of students. Students also have such

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low self-confidence that they are not sure to succeed. This uncertainty causes dissatisfaction for students because the results obtained can not make them get a compliment or appreciation from others. Therefore, there needs to be efforts to increase learning motivation and mastery of students' concepts. One of the efforts made is to use the *Process Oriented Guided Inquiry Learning* (POGIL) model which is cooperative learning rooted in constructive theory.

The POGIL model is a learning model that prioritizes student-centered learning to encourage active participation of students and cooperate with groups in the classroom so that the ability to master concepts can develop (Fitriani, Irwandi & Murniati, 2017). Furthermore, students need to be given more opportunities to analyze questions, make some conclusions, develop concepts, solve unstructured problems and evaluate and reflect their findings. Thus, this POGIL learning will provide opportunities for students to instruct their understanding in the group (Saputro, Rohaeti & Prodjosantoso, 2018).

Methods

The first step is to perform the n-Gain calculation by reducing the postest by the pretest score and then divided by the result of the maximum score reduction by the pretest score (Hake, 2002).

The second step is to analyze the results of observations of students' activities during learning in experimental class and control class. Analysis of the results of observations of student activities is done by calculating the number of scores given by observers for each aspect of observation, then calculating the percentage of ability. Then interpret the data results with criteria according to Arikunto (2013).

The third step is to analyze the results of the student's response to the use of the POGIL model in the experimental class. Analysis of the results of the student response questionnaire is done by calculating the number of scores of each learner. then the percentage of questionnaires and interpreting the results of the data with criteria according to Arikunto (2013).

The fourth step is to analyze the results of observations of teacher' abilities in managing learning with POGIL. Analysis of the results of observation of students' abilities is done by calculating the number of scores given by observers for each aspect of observation. Then calculate the average percentage of students' abilities. Then interpret the data results with criteria according to Arikunto (2013).

The n-Gain score obtained is then used for hypothesis testing. The first test is the normality test. The normality test is used to find out whether two sample groups are from a normal distributed population or not (Arikunto, 2013). The test criteria are to accept H_0 if the sig (p) score of Shapiro-Wilk > 0.05; and to receive H_1 if the sig(p) score from Shapiro-Wilk < 0.05 (Sudjana, 2005).

The second test is the homogeneity test. This test is done to find out if the sample compared has an identical average score and variance. The test criteria are to receive H_0 if the sig(p) score of Statistics > 0.05; and accept H_1 if the sig(p) score of Levene Statistics levene < 0.05 (Sudjana, 2005).

The third test is a difference of two on average. This test was conducted to find out if the average n-Gain of learning motivation and mastery of students' concepts between experimental class and control class differed significantly. If the research data obtained is normal distribution and has a homogeneous variance, test the difference of two averages used in this study is to use indepent t-test samples. The test criteria accept H_0 if the sig (2-tailed) score < 0.05 and accept H_1 if the sig (2-tailed) score > 0.05 (Sudjana, 2005).

The last test is the influence test. This test is done to find out how much increased motivation to learn and master the concept of students. Effect size criteria as according to Dyncer (2015).

Results

Table 1. Results of Analysis of Average Value n-Gain Motivation Learning

Class	*n-Gain*	Information
Experiimentalt	0,67	Keep
Control	0,52	Keep

Table 2. Results of Analysis of Average Value n-Gain Mastery of Concepts

Class	*n-Gain*	Information
Experiimentalt	0,65	Keep
Control	0,47	Keep

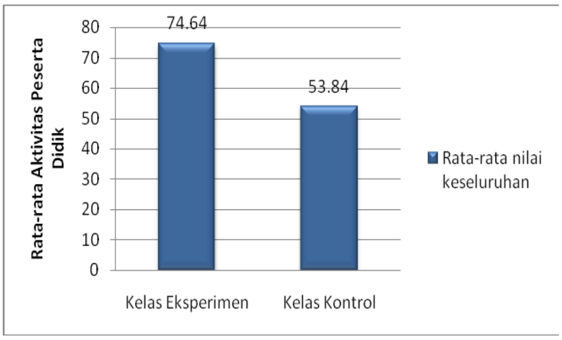

Figure 1. Average Scores of Students' Activities in Experiimentalt and Control Class

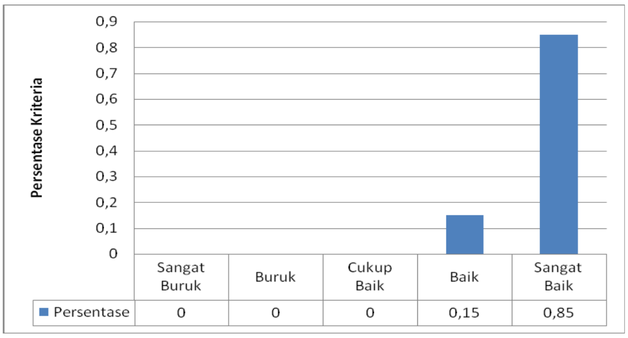

Figure 2. Percentage Criteria for Students' Response to the Use of POGIL Model

Table 3. Results of Data Analysis of Teachers' Abilities in Managing Learning

Aspects of Observation	Percentage of Educators' Abilities (%) meet-				Average (%)
	1	2	3	4	
Introduction	68,75%	81,25%	84,38%	93,75%	82.03%
Stage 1	68,75%	75%	84,38%	90,63%	79.69%
Stage 2	68,75%	75%	84,38%	90,63%	79.69%
Stage 3	59,38%	68,75%	81,25%	87,5%	74.22%
Stage 4	75%	81,25%	93,75%	100%	87.50%
Stage 5	75%	81,25%	81,25%	93,75%	82.81%
Assessment of educators	65%	75%	85%	90%	78.75%
Average	68.66%	76.79%	84.91%	92.32%	80.67%

Aspects of Observation	Percentage of Educators' Abilities (%) meet-				Average (%)
	1	2	3	4	
Interpretation of Criteria	**High**	**High**	**Very High**	**Very High**	**Very High**

Table 4. Normality Test Results n-Gain Learning Motivation Students

Class	N	n-Gain	
		Sig value.	Criterion
Experiimentalt	34	0,138	Sig. >0.05
Control	34	0,115	Sig. >0.05

Table 5. Normality Test Results n-Gain Mastery of Concepts Students

Class	N	n-Gain	
		Sig value.	Criterion
Experiimentalt	34	0,809	Sig. >0.05
Control	34	0,714	Sig. >0.05

Table 6. Homogeneity Test Results n-Gain Learning Motivation Students

Class	N	n-Gain	
		Sig value.	Criterion
Experimental	34	0,554	Sig. >0.05
Control	34		

Table 7. Results of Homogeneity Test n-Gain Mastery of Students Concept

Class	N	n-Gain	
		Sig value.	Criterion
Experiimental	34	0,191	Sig. >0.05
Control	34		

Table 8. Results of Independent Test Sample T-Test Motivation Learning Students

Class	Average *n-Gain*	Sig. (*2-Tailed*)	Test Criteria
Experiimental	0,67	0,018	Sig. < 0.05
Control	0,52		

Table 9. Results of Independent Test Sample T-Test Mastery of Concept Students

Class	Average n-Gain	Sig. (*2-Tailed*)	Test Criteria
Experiimental	0,65	0,00	Sig. < 0.05
Control	0,47		

Table 10. Data Results of Effect Size Calculation of Learning Motivation Students

Class	T	t^2	µ	Criteria
Experimental	-10,086	101,727	0,869	Big
Control	- 6,415	41,152	0,745	moderate

Table 11. Data Results of Effect Size Calculation of Mastery Concept Students

Class	T	t^2	µ	Criteria
Experimentalal	-21,023	441,967	0,965	Big
Control	-13,671	186,896	0,722	moderate

Discussion

The results showed that the average score of the learning motivation questionnaire of students in the experimental class was 58.52, and after applying the POGIL model the average score became 89.59. In the control class, it was seen that the average score of the learner's motivation questionnaire was 59.85, and after learning without the POGIL model, the average score became 83.36. When viewed from the difference in the average value of pretest and postest, in the experimental class there was an increase of 31.07, while in the control class there was an increase of 23.51. This shows that the average score of learning motivation questionnaire students with learning using the POGIL model is higher than the learning motivation of students who in learning do not use the POGIL model.

In mastery of concept, the acquisition of the average pretest in the experimental class was 51.47 and the acquisition of postest average score after using the POGIL model was 83.29. While in the control class, the acquisition of the average pretest score was 52.47 and the acquisition of postest average score without using the POGIL model of 75.18. Judging from the difference between the pretest and postest, in the experimental class there was an increase of 31.82, while in the control class there was an increase of 22.71. This shows that the average score of mastery of the concept of students who in learning using the POGIL model is higher than the mastery of the concept of students who in learning do not use the POGIL model.

The pretest and postest obtained are then used to obtain the n-Gain value. The average n-Gain of students' learning motivation in experimental class was 0.67 higher than the control class's n-Gain average score of 0.52 so it could be said that the application of the POGIL model in the experimental class increased learning motivation better than control class that did not implement the POGIL model. This is in line with the statement put forward by Wicaksono (2008), that the learning model is said to be effective in increasing motivation if after learning students become more motivated to study harder and get good learning results.

The results of calculations on the mastery of the concept of buffer solution also showed that there was a difference between n-Gain mastery of the concept students in experimental class and control classes. The average n-Gain score of experimental class concept mastery is higher than the control class, so it can be said that the application of the POGIL model in the experimental class can increase mastery of the concept of buffer solution better than the control class that does not apply the POGIL model.

Learning with POGIL model can increase the mastery of concepts learners because in the learning process through stages that can train the analytical thinking process of learners. Existing activities at the orientation stage require students to be able to predict the concept of buffer solutions before conducting the exploration stage. Then at the exploration stage, learners are directly involved in learning, such as practicums. Students will more easily understand a concept if students are directly involved in the process of finding the concept (Aulia, 2017). At the concept discovery stage, learners are guided to answer questions that can lead students to discover a concept (Hanson 2006) and trained to explain concepts using their own language in group discussions that can provide opportunities for students to reveal and explain the information they have obtained (Aulia &Yunita 2017). At the application stage learners apply the concepts that have been found in the previous stage into the training questions provided by teacher. Practice gives student the opportunity to build their confidence. A person who has a confident attitude is likely to succeed (Keller, 2009). Then in the closing stages, the learning activity ends by validating the results they have achieved. Validation is done by reporting the results that have been obtained with classmates and teacher to find out their perspective on the results of the work that has been obtained. When student know the results obtained well, then student will maintain even develop good results (Hanson, 2006). After the learning process is completed, teacher appreciate the work of student. This is intended to appreciate the performance of students. In line with what Keller (2009) put forward about motivational indicators, learning that one feels satisfied and proud because of what is done and produced gets good appreciation from others.

Then do an effect size test. The results of the learning motivation effect size test showed that an 86.9% increase in students' learning motivation in the experimental class was influenced by the application of the POGIL model, where the test results showed the criteria for "large effects". Then the results of the concept mastery effect size test showed that a 96.5% increase in mastery of the concept of buffer solution of students in the experimental class was influenced by the application of the POGIL model, where the test results also showed the criteria of "large effect". This shows that the POGIL model has an effect on learning motivation and mastery of the concept of buffer solution students'. Learning with the POGIL model first prepares yourself for the material to be studied by students. Therefore, students have readiness in the form of knowledge and understanding of the initial concepts in the material to be studied (Rahayu, 2015). The advantages of other POGIL learning methods are that students can process information, think critically, solve problems, communication, teamwork, management and self-assessment, while the teacher as a facilitator is observing the work of the student group, answering questions, and intervening if needed (Straumanis, 2014).

The effectiveness of the POGIL model to increase learning motivation and mastery of the concept of buffer solutions of student is supported by the results of observation of activities and response questionnaires of student. The results of observations of the activities of student showed that during the learning process in the experimental class had an average value from the first meeting to the fourth meeting (last meeting) higher than the average score in the control class. The difference in average scores lies most in the aspect of paying attention as learning progresses and engaging in group discussions. In the experimental class, student follow the learning process well. Student pay attention to what is conveyed by teacher, pay attention to what is asked or conveyed by other student. Student are also given their respective roles by teacher in each group so that the discussion process can run well. In the control class, the learning process is less well followed by student. The absence of group division and the role of group members by teacher causes the classroom atmosphere to be not conducive. This led to a higher percentage of the percentage of the average activity of student in the experimental class compared to the percentage of the average value of control class activity. The high percentage of average scores of student activity in the experimental class showed that the student's activity during learning was better, active and enthusiastic than the control class. In line with Nieveen (2013) that the learning model can be said to be effective if student are actively involved in organizing and finding relationships and information provided and not only passively receiving knowledge from teacher.

The results of the analysis of student response data to the POGIL model showed that the average percentage of student responses was "very high". That is, students are very helpful and happy with the application of the POGIL model on buffer solution learning. This is indicated by attitudes such as students more easily understand learning materials, confidence of students increases, dare and accustomed to expressing opinions in group discussions and class discussions. The positive response given by students is in line with previous research by Risandi (2015) which states that the results of the analysis of the student response questionnaire show a positive response because students find the learning provided is fun, not boring so that there is a desire to know more about the material received.

Aspects of learning effectiveness with the POGIL model can also be determined by the educator's ability to manage learning. Educators' ability to manage learning based on the results of analysis of observation sheet data conducted by two observers has increased at each meeting. The lowest percentage at the first meeting was at the concept discovery stage of 74.22%. This is because at the time in the learning laboratory is less conducive. Students prefer to talk to their group mates or just daydream, but in later meetings educators are better at conditioning the classroom. The largest percentage is at the application stage at the fourth meeting, this is because at this stage educators have been able to guide students to strengthen and expand understanding of the concepts that have been found before by working on training problems on the student worksheet. Hanson (2006) states that exercise gives students *the* opportunity to build confidence (one of the indicators of learning motivation, ARCS) by providing simple problems or familiar context.

The results of the two-average difference test (t-test) showed that the pretest score was not the same as the postest score or in other words the test results changed. This suggests that using the POGIL model in learning can lead to a difference between pretest and postest score or in other words an increase in mastery of concepts and learning motivation. Increased mastery of concepts indicates that students are motivated to learn.

Conclusion

Based on the results of data analysis and hypothesis testing that has been done, efforts to increase learning motivation and mastery of the concept of buffer solutions can be done by applying the POGIL model. Motivation to learn and master the concept of solution students in experimental class that use the POGIL model is higher than the control class that uses lecture methods.

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