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The Effectiveness of POGIL Model to Increase Self Confidence and Mastery of Students' Buffer Solution Concept

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Abstract: The effectiveness of the POGIL Model to increase Self Confidence and Mastery of the Student Buffer Solution Concept. This study aims to describe the effectiveness of the POGIL model to increase students' self-confidence and mastery of the buffer solution concept. The population in this study were all students of class XI IPA at SMA Negeri 12 Bandar Lampung. The research sample was taken using cluster random sampling technique, and obtained class XI IPA 3 as the experimental class and XI IPA 4 as the control class. The method in this research is a quasi-experimental with a pretest-posttest control group design. The POGIL model is said to be effective if it shows a significant difference in the value of n-Gain self confidence and students' mastery of concepts between the experimental class and the control class. The results showed that the mean value of n-Gain self-confidence of students in the experimental class was 0.65 including the "moderate" criteria and the control class was 0.26 including the "low" criteria. The average n-Gain value of students' concept mastery in the experimental class was 0.65 including the "moderate" criteria and the control class was 0.47 including the "moderate" criteria. Based on these results, it can be concluded that the POGIL model is effective in increasing students' self-confidence and mastery of the buffer solution concept.

Keywords: POGIL models, self confidence, mastery of concepts, buffer solution

Abstrak:Efektivitas Model POGIL untuk Meningkatkan Self Confidence dan Penguasaan Konsep Larutan Penyangga Peserta Didik. *Penelitian ini bertujuan untuk mendeskripsikan efektivitas model POGIL untuk meningkatkan self confidence dan penguasaan konsep larutan penyangga peserta didik. Populasi dalam penelitian ini adalah seluruh peserta didik kelas XI IPA di SMA Negeri 12 Bandar Lampung. Sampel penelitian diambil menggunakan teknik cluster random sampling, dan diperoleh kelas XI IPA 3 sebagai kelas eksperimen dan XI IPA 4 sebagai kelas kontrol. Metode dalam penelitian ini adalah kuasi eksperimen dengan pretest-postest control grup design. Model POGIL dikatakan efektif apabila menunjukkan perbedaan nilai n-Gain self confidence dan penguasaan konsep peserta didik yang signifikan antara kelas eksperimen dan kelas kontrol. Hasil penelitian menunjukkan bahwa rata-rata nilai n-Gain self confidence peserta didik di kelas eksperimen sebesar 0,65 termasuk kriteria "sedang" dan kelas kontrol sebesar 0,26 termasuk kriteria "rendah". Rata-rata nilai n-Gain penguasaan konsep peserta didik di kelas eksperimen sebesar 0,65 termasuk kriteria "sedang" dan kelas kontrol sebesar 0,47 termasuk kriteria "sedang". Berdasarkan hasil penelitian tersebut, dapat*

disimpulkan bahwa model POGIL efektif dalam meningkatkan self confidence dan penguasaan konsep larutan penyangga peserta didik

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Kata kunci: *model POGIL, self confidence, penguasaan konsep, larutan penyangga*

▪ INTRODUCTION

Natural Science (IPA) is a science that is related to how to systematically find out about natural phenomena, so that Science is not only knowledge in the form of facts, concepts, or principles but also a process of discovery in the form of a product of knowledge (Susanto, 2013). The learning process emphasizes providing direct experience to develop competencies so that students are able to explore and understand the natural surroundings scientifically (BSNP, 2006).

One of the clumps of science is chemistry. Chemistry is the study of various natural phenomena related to composition, structure and properties as well as changes that involve skills and reasoning (Depdiknas, 2006). Therefore, chemistry learning must be more directed at the learning process that can enable students to understand the concepts in chemistry learning, but based on the results of research conducted by Ngabidin (2005) about 89% of 176 students have difficulty learning chemical concepts compared to concepts another lesson. This difficulty in studying chemistry can be due to the fact that most of the concepts studied in chemistry are abstract. The ability of students to understand chemical concepts will have an impact on student learning outcomes in the form of mastery of concepts (Prasinta, 2018).

Students who are able to master chemical concepts well will be able to solve chemical problems related to these materials, so that students can improve their mastery of concepts. This is in accordance with the results of Widiyowati's (2014) research which states that the ability of students to understand chemical concepts has a positive and significant relationship to student learning outcomes, meaning that the higher the students 'mastery of chemical concepts, the higher the students' learning outcomes of chemistry. Therefore, mastery of concepts is very important in learning.

In addition to cognitive abilities in the form of mastery of concepts, chemistry learning will be successful when cognitive abilities and affective abilities are developed together. One of the affective abilities that can be developed is self confidence. Self confidence is a positive attitude of an individual who enables him to develop a positive assessment of himself and his surroundings (Suhendri, 2012). A person who is confident will believe in his own abilities, in general can control himself, and believe in his ability to do what is planned and achieved (Srivastava, 2013). Therefore, it is very important for students to develop self-confidence in learning chemistry.

Based on the results of observations and interviews with one of the educators in chemistry subjects at SMA Negeri 12 Bandar Lampung, data was obtained that learning chemistry, especially buffer solution material, has used the 2013 curriculum, but in practice it is still centered on educators. During learning, educators explain more often and only give questions to students. Educators also rarely train students to do experiments and more often display experimental data. If the chemistry learning process in schools only presents concepts and theories without presenting students how the process of finding concepts and theories will be difficult to foster scientific attitudes in students. This results in many students being passive. Lack of active students during the

learning process, resulting in student learning outcomes in the form of mastery of concepts is still very low.

In addition, students also still have a low level of self-confidence. One of the visible aspects is self-confidence. Learning in the classroom shows that most students do not have confidence in their ability to work on the questions given by the educator and always think that the questions are difficult. Another aspect that has not been achieved is an optimistic attitude. This can be seen from the existence of several students who were appointed by the educator to work on the questions in front of the class, but some of these students refused. This attitude reflects that these students do not have an optimistic attitude about their abilities.

Based on these problems, it is necessary to improve the learning model in order to overcome the low self-confidence and mastery of students' concepts. One of the efforts that need to be made to improve the learning model in the classroom is by using the POGIL model.

The Process Oriented Guided Inquiry Learning (POGIL) model is a collaborative learning technique that uses guided inquiry in which there is an interconnected system, namely orientation, exploration, concept discovery, application and evaluation (De Gale & Boisselle, 2015). The POGIL model teaches students to work together in a team so that this learning activity can develop the nature of individual responsibility of students and train good teamwork. The use of the POGIL model at each learning step is expected to increase students' self-confidence and conceptual mastery.

The success of the POGIL model is supported by several previous research results, Eberlein, Kampmeier, Minderhout, Moog, Plat, Nelson & White (2008) comparing problem-based learning, peer-led team learning and POGIL models, the results show that the POGIL model can increase the value of performance, and create a more active and pleasant classroom conditions. Another study was conducted by Villagonzalo (2014) which compared the conventional learning model and the POGIL model to the performance value of students, the results showed that the POGIL model could increase the performance value of students better than conventional learning.

Based on the description, this article describes the effectiveness of the POGIL model in increasing students' self-confidence and mastery of the buffer solution concept.

▪ METHOD

This research was conducted at SMA Negeri 12 Bandar Lampung. The population in this study were all students of class XI IPA at SMA Negeri 12 Bandar Lampung who were spread over 5 classes. The sample was taken using cluster random sampling technique, in order to obtain class XI IPA 3 as the experimental class and XI IPA 4 as the control class. The method used in this study was a quasi-experimental with a pretest-posttest control group design. In this study design saw the differences in the pretest and posttest between the experimental class and the control class before and after being given treatment. The pretest-posttest control group design research design can be seen in Table 1

Table 1. Research design pretest-posttest control group design

Research Class	Pretest	Treatment	Postes
Experiment	O1	X1	O2
Control	O1	C	O2

Information:
O1: The experimental class and the control class are given a concept mastery pretest
X1: Treatment of the experimental class (Learning using the POGIL Model)
C: Control class treatment (Learning without using the POGIL Model)
O2: The experimental class and the control class are given a concept mastery posttest.

The independent variable in this study is the learning model used, namely the use of the POGIL model in the experimental class and conventional learning in the control class. The dependent variable is students' self-confidence and conceptual mastery. The control variable is the buffer solution material.

The preliminary stage procedures in this research are (1) asking permission from the Principal of SMA Negeri 12 Bandar Lampung to carry out the research; (2) make observations with the class XI chemistry teacher; (3) determine the population and research sample; (4) preparing learning tools and research instruments, namely syllabus, lesson plan (RPP), LKPD based on the POGIL model, self-confidence questionnaire consisting of 38 statements, concept mastery pretest-posttest questions consisting of 10 description questions, learning implementation observation sheets using the POGIL model, student activity observation sheets and student response questionnaires to the POGIL model; (5) perform validity and reliability of research instruments.

At the implementation stage, the research was carried out in the experimental class and the control class. The procedures for the implementation stage in this study were (1) conducting a pretest and distributing the initial self-confidence questionnaire to the experimental class and the control class; (2) carrying out learning activities on the buffer solution material, learning using the POGIL Model applied in the experimental class and conventional learning being applied in the control class; (3) make observations about the implementation of learning using the POGIL model; (4) make observations about the activities of students during learning; (5) provide a questionnaire for students' responses to the POGIL model; (6) conducting post-tests and distributing the final self-confidence questionnaire to the experimental class and the control class. The procedures at the final stage of the study were (1) conducting data analysis; (2) discussing the research results and (3) drawing conclusions.

Data processing using SPSS version 23.0 for Windows and Microsoft Office Excel software. Data analysis of self-confidence and students' mastery of concepts on the buffer solution material seen from the n-Gain obtained from the pretest and posttest values. The pretest and posttest results obtained are still in the form of scores not values, so they must convert the scores into values. The pretest and posttest scores are obtained by the following formula:

$$Final\ score = \frac{\sum Score\ obtained\ by\ students}{Maximum\ Score}\ x\ 100$$

The data obtained were then analyzed, by calculating *n-Gain* which was then used for hypothesis testing. Determination to determine the amount of increase in the

value of self-confidence and mastery of students' concepts can be shown through the acquisition of the *n-Gain* score, which is the difference between the post-test and pretest scores. Refraction on the *n-Gain* score can be avoided by normalizing the *n-Gain* score by referring to the formula proposed by (Sudjana, 2005) which is:

$$The\ formula\ for\ the\ n-Gain\ value = \frac{posttest\ scores - pretest\ scores}{the\ maximum\ value - pretest\ value}$$

The *n-Gain* criteria (Hake, 2002) are:
a) Learning with a "high" *n-Gain* score if *n-Gain*> 0.7
b) Learning with a "moderate" *n-Gain* score lies between 0.3 <*n-Gain*≤0.7
c) Learning with a "low" *n-Gain* score if *n-Gain* ≤ 0.3.

After data processing, an analysis of the n-Gain value obtained using SPSS version 23.0 was carried out to obtain normality, homogeneity, and the difference between the two mean self-confidence data and the students' mastery of concepts from the two samples. The normality of the data was tested through the Kolmogorov Smirnov Test with a significant level> 0.05. The homogeneity of the data was tested by using the Levene Test with a significant level> 0.05. The test for the difference between the two means was carried out by using the independent sample t-test of the average n-Gain value of self-confidence and the conceptual mastery of students in both samples. Based on the results of the test for the difference between the two average self-confidence and students 'mastery of concepts, then the effect size calculation is carried out to determine how much influence the POGIL model has to increase students' self-confidence and mastery of the buffer solution concept. Effect size relates to the success rate of a treatment applied in a lesson. The formula for the effect size according to Jahjouh (2014) is as follows.

$$\mu = \frac{t^2}{t^2 - df}$$

▪ RESULTS AND DISCUSSION

Based on the research that has been done, data were obtained in the form of the results of self-confidence questionnaires and the results of students' mastery of concepts. Other supporting data were also obtained, namely in the form of observation data on the implementation of learning using the POGIL model, data from observations of student activities, and questionnaire data on students' responses to the POGIL model.

The validity and reliability of the self-confidence questionnaire and the concept mastery pretest-posttest questions had been measured, it was stated that the self-confidence questionnaire and the pretest-posttest questions of concept mastery were valid and reliable with "very high" criteria, so that the two test instruments were declared fit to be used to measure self-confidence and mastery of students' concepts.

After conducting the research, data were obtained in the form of pretest and posttest self-confidence questionnaire values. The average results of the pretest and posttest scores in the control class and experimental class can be seen in Figure 1 below;

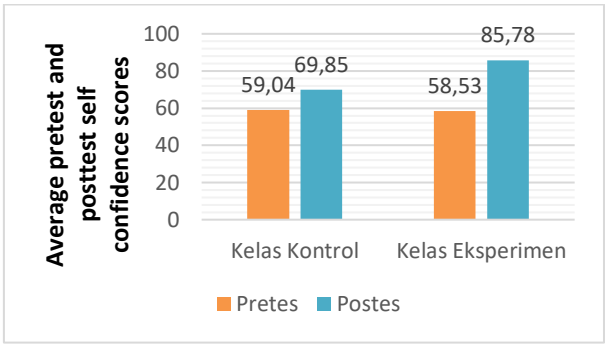

Figure 1. The average pretest and posttest value of students' self confidence

The picture above describes that the self-confidence of students after learning is better than before learning is applied, both in the control class and in the experimental class. The increase in the average pretest to posttest value in the experimental class was 27.25. This value is greater than the control class with an increase in the average pretest to posttest score of 10.81. This shows the increase in the mean value of the pretest-posttest self-confidence in the experimental class is higher than the control class.

The increase in students 'self confidence is shown through the *n-Gain* value, the average *n-Gain* value of the students' self confidence questionnaire in the experimental class and control class is shown in the following figure.

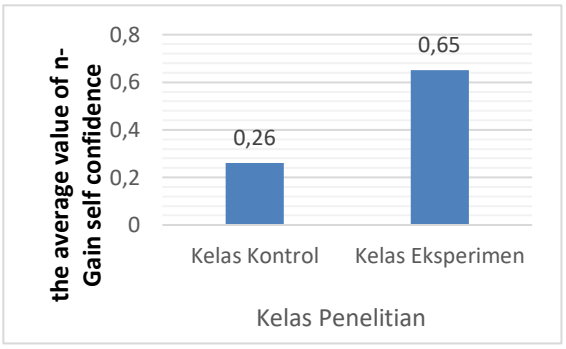

Figure 2. The average value of students' *n-Gain* Self Confidence

Based on Figure 2 above, it can be seen that the average n-Gain self confidence value in the control class is 0.26 with a "low" criterion and in the experimental class it is 0.65 which has a "medium" criterion. Based on these results it can be seen that the average *n-Gain* self-confidence of the experimental class is higher than the average n-Gain self-confidence of the control class, so it can be stated that learning using the POGIL model is effective in increasing students' self-confidence in the buffer solution material. The results of this study are in accordance with the results of research conducted by Fuaidah (2017) where the use of LKPD based on a contextual approach such as the POGIL model can increase students' self-confidence.

Furthermore, the students 'mastery of the concept data on the buffer solution material came from the students' pretest-posttest value data. The average results of the pretest and posttest scores in the control class and experimental class can be seen in Figure 3 below:

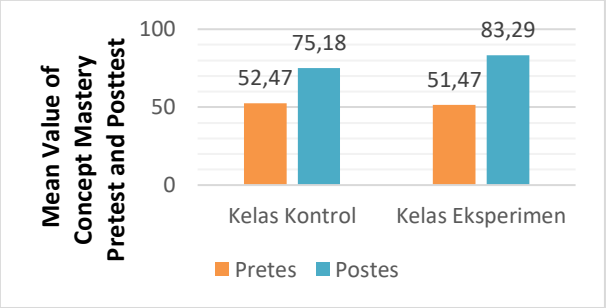

Figure 3. The average value of the pretest and posttest about the students' conceptual mastery.

The picture above describes that the students' mastery of concepts after learning is better than before learning is applied, both in the control class and in the experimental class. Based on the results of the calculation, it shows that the increase in the average value of the pretest to posttest mastery of the concept in the experimental class is higher than the control class. The increase in students 'concept mastery is shown through the *n-Gain* value, the average *n-Gain* value of students' concept mastery in the experimental class and control class as in the following figure.

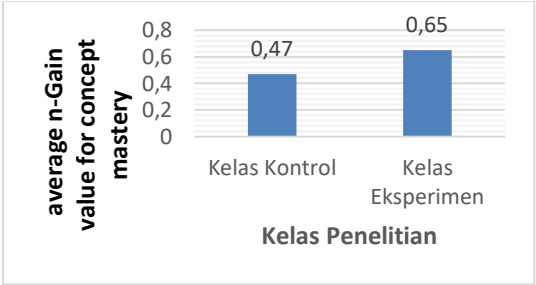

Figure 4. Average n-Gain value of Students' Concept Mastery

Based on the average *n-Gain* value found in Figure 4, it can be seen that the average *n-Gain* value obtained in the control class is 0.47 and the average n-Gain value obtained in the experimental class is 0.65. This shows that the average *n-Gain* value of students' concept mastery in the control class and the experimental class has "moderate" criteria. Based on these data, it can be seen that the average *n-Gain* value in the experimental class is higher than the average *n-Gain* value in the control class, so it can be stated that learning using the POGIL model is effective in increasing students' mastery of concepts on the buffer solution material. .

Furthermore, the analysis of the learning implementation data using the POGIL model is only as supporting data. The implementation of learning in this study was observed during the learning process by 2 observers. The calculation results are presented in Table 2 below.

Table 2. Results of Learning Implementation Data using the POGIL Model

No	Observational Aspects	Percentage of Implementation (%)				Average
		1	2	3	4	
1	preliminary	68,75%	81,25%	84,38%	93,75%	82,03%
2	Stage 1: Orientation	62,5%	75%	81,25%	87,5%	76,56%
3	Stage 2: Exploration	68,75%	75%	84,38%	90,63%	79,69%
4	Stage 3: Concept Discovery	59,38%	68,75%	81,25%	87,5%	74,22%

Continued Table 2. Results of learning implementation data using the POGIL Model

No	Observational Aspects	Percentage of Implementation (%)				Average
		1	2	3	4	
5	Stage 4: Application	75%	81,25%	93,75%	100%	87,5%
6	Stage 5: Closing	75%	81,25%	81,25%	93,75%	82,81%
7	Assessment of educators	65%	75%	85%	90%	78,75%
Average		**67,76%**	**76,78%**	**84,46%**	**91,87%**	**80,22%**
Criteria		**High**	**High**	**Very high**	**Very high**	**Very high**

Based on the table, it is known that the average percentage of late learning using the POGIL Model on the buffer solution material has a "very high" criterion. Based on these data, it is known that there is an increase in the percentage of implementation in each lesson.

The ability of educators to manage good learning will determine the success of an effective learning process so that the desired learning objectives can be achieved (Suprayanti, Ayub & Rahayu, 2016). This can also be seen from the number of students who are active in the learning process to find the concept of a material independently, look for a concept in detail and present it in front of their friends with confidence in the buffer solution material. This indicates that with the stages of the POGIL model self confidence and mastery of concepts students can be trained and begin to get used to it.

In addition to observations of the implementation of learning using the POGIL model, observations of students' activities in the experimental class and control class were also carried out which were measured when the learning process took place starting from the introduction to the closing activities which were measured using 7 aspects. This observation uses a sample of 10 students and is assessed by two observers. The results of data analysis on the activity of observations of students in the experimental class can be seen in Table 3 below.

Table 3. The percentage of students' activity frequency in the experimental class

No	Aspects Observed	Meeting				Average
		1	2	3	4	
1	Pay attention and listen to educators' explanations when learning takes place	65	80	90	100	83,75
2	Identify problems and formulate hypotheses	65	75	85	90	78,75
3	Get involved in working on LKPD / group discussions.	55	70	80	80	71,25
4	Combining new ideas into existing knowledge when answering or asking questions.	55	70	75	85	71,25
5	Presenting the results of the discussion / responding to the presentations of other groups	60	70	80	85	73,75
6	Verifying the previously formulated hypotheses ..	60	65	75	85	71,25

No	Aspects Observed	Meeting				Average
		1	2	3	4	
7	Involved in concluding the results of the discussion or assessing the learning process that has taken place.	55	70	80	85	72,5
Percentage of student activity frequency (%)		59,28	71,43	80,71	87,14	74,64
Criteria		Moderate	High	Very high	Very high	High

Based on table 3 above, the average activity of students in the experimental class has an increasing percentage of each meeting. The average percentage of student activity during learning on the buffer solution material in the experimental class as a whole from the first, second, third and fourth meetings has "high" criteria.
The results of data analysis on the activity of observations of students in the control class can be seen in Table 4 below.

Table 4. The percentage of students' activity frequency in the control class

No	Aspects Observed	Meeting				Average
		1	2	3	4	
1	Pay attention and listen to educators' explanations when learning takes place	55	60	70	75	65
2	Identify problems and formulate hypotheses	45	55	55	60	53,75
3	Get involved in working on LKPD / group discussions.	50	50	55	65	55
4	Combining new ideas into existing knowledge when answering or asking questions.	50	50	55	65	55
5	Presenting the results of the discussion / responding to the presentations of other groups	50	50	55	65	55
6	Verifying the previously formulated hypotheses ..	40	50	55	60	51,25
7	Involved in concluding the results of the discussion or assessing the learning process that has taken place.	40	50	50	65	51,25
Percentage of student activity frequency (%)		47,14	52,14	56,42	64,99	55,17
Criteria		Moderate	Moderate	Moderate	High	Moderate

Based on table 4 above, the average activity of students in the control class has an increasing percentage of each meeting. The average percentage of student activity during learning on the buffer solution material in the control class as a whole from the first, second, third and fourth meetings has "moderate" criteria.

The increase in the activity of students in the experimental class is higher than the control class, this is because in the experimental class learning is applied using the POGIL model. In a class that applies the POGIL model, educators are able to encourage students to be more active and confident in speaking in class at each meeting with the aspects applied. This shows that there is an influence between learning using the POGIL model applied to student learning activities so that students can improve their learning outcomes.

The effect of learning using the POGIL model is also seen from the responses of students to their interest in learning in class. Student responses were measured using a student response questionnaire to the POGIL model. In Figure 5 below, it can be seen how the percentage of students' responses to the POGIL model.

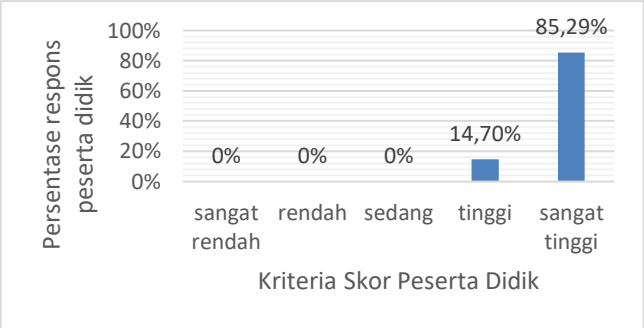

Figure 6. Percentage of students' responses to the POGIL Model

The results of the student response questionnaire data analysis showed that the use of the POGIL model had very high criteria in the learning process. Based on these results, it shows that students are more interested in or prefer learning using the POGIL model compared to using the conventional model.

Furthermore, the results of the *n-Gain* value of self-confidence and students' mastery of concepts obtained were then tested for normality, homogeneity and the difference between the two averages. The results of the normality test for the *n-Gain* value of self confidence in the control class resulted in a sig. amounted to 0.157, while in the experimental class that was equal to 0.200. Based on these results, it shows that the normality test results on the value of *n-Gain* self confidence have a sig value. > 0.05, so that the test decision is to accept H_0 and reject H_1, which means that the research data obtained comes from a normally distributed population.

The results of the normality test of the *n-Gain* value for mastery of the concept in the control class and experimental class resulted in a sig value. equal to 0.200. Based on these results, it shows that the normality test results on the *n-Gain* value of concept mastery have a sig value. > 0.05, so that the test decision is to accept H_0 and reject H_1, which means that the research data obtained comes from a normally distributed population.

The homogeneity test results of the *n-Gain* self-confidence value in the control class and the experimental class produced a sig value. amounting to 0.113. Based on the results of the homogeneity test on the value of *n-Gain* self confidence in the control class and the experimental class, it has a *sig*> 0.05, so the test decision is to accept H_0 and reject H_1, which means that the two samples have a homogeneous variance value.

The results of the homogeneity test of the *n-Gain* value of concept mastery in the control class and experimental class resulted in a sig value. amounting to 0.191. Based on the results of the homogeneity test on the *n-Gain* value of concept mastery in the control class and the experimental class, it has a *sig*> 0.05, so the test decision is to accept H_0 and reject H_1, which means that the two samples have a homogeneous variance value.

Because the data obtained were normal and homogeneous, a test for the difference between the two average n-gain values was carried out using parametric statistical tests, namely by using the Independent Samples T-test. The test results of the difference

between the two mean *n-Gain* self-confidence values and the *n-Gain* value of concept mastery have a sig value. by 0.00. Based on the test results, it shows that the sig. (2-tailed) of the t-test for equality of means <0.05, so the decision to accept H_0 and reject H_1 which means there is a significant difference in the average *n-Gain* value of self-confidence and the average *n-Gain* value. mastery of concepts in the control class and experimental class. The average *n-Gain* self-confidence value and the average *n-Gain* value of students' concept mastery in the experimental class applied to the POGIL model were higher than the average *n-Gain* self-confidence value and the average n-Gain value of concept mastery students in the control class who applied the conventional model to the buffer solution material.

Furthermore, the two-mean difference test was carried out on the pretest and posttest results to get the t value that would be used in the effect size test using the POGIL model in the experimental class. The result of the difference between the two mean values of the pretest posttest self-confidence and the pretest posttest of mastery of the concept has a sig value. by 0.00. Based on these results, it shows that in the experimental class and control class the sig. (2-tailed) of the t-test for equality of means <0.05, so the decision to accept H_0 and reject H_1 which means that there is a significant difference between the average pretest and posttest self-confidence of students in the experimental class and the control class. .

The results of the calculation of the difference test, with the value of t and the degrees of freedom (df) obtained, are used to determine the effect size. Based on the results of the calculation of the effect size self confidence test of students in the experimental class applied to the POGIL model, it shows that 97% increase in students 'self confidence is influenced by learning using the POGIL model on buffer solution material, while in the control class 89% increase in students' self confidence is influenced by conventional learning.

The results of the calculation of the effect size test of students' concept mastery in the experimental class that were applied to the POGIL model showed that 94% of the increase in students' concept mastery abilities was influenced by learning using the POGIL model on buffer solution material, while in the control class 85% the increase in the participants' concept mastery ability students are influenced by conventional learning.

▪ CONCLUSION

Berdasarkan analisis data hasil penelitian dan pembahasan dapat disimpulkan bahwa: (1) Model POGIL efektif untuk meningkatkan *self confidence* dan penguasaan konsep larutan penyangga peserta didik. Hal tersebut dapat ditunjukkan dari perbedaan yang signifikan antara nilai *n-Gain* pada kelas kontrol dan kelas eksperimen, dimana kelas eksperimen memiliki rata-rata nilai *n-Gain* yang lebih besar daripada kelas kontrol. (2) Ukuran pengaruh *(effect size)* model POGIL untuk meningkatkan *self confidence* dan penguasaan konsep larutan penyangga peserta didik berkriteria “besar”, sehingga berpengaruh positif untuk meningkatkan *self confidence* dan penguasaan konsep larutan penyangga peserta didik.

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