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The Effectiveness of the POGIL Model to Improve Self-Efficacy and Mastery of the Buffer Solution Concept

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Abstract: The Effectiveness Of POGIL Model to Improve Self Efficacy and Concept Mastery Of Buffer Solution. This research was aimed to describe the effectiveness of POGIL model to improve self efficacy and concept mastery of students' buffer solution. This study used a quasi-experimental method with pretest-posttest control group design. The population in this study was all students of class XI IPA SMA Negeri 12 Bandar Lampung in 2019/2020 Academic Year. The sample in this study was class XI IPA 3 as experimental class and class XI IPA 4 as control class. The research sample was selected by using cluster random sampling tehnique. The Effectiveness Of POGIL Model is measured to Improve Self Efficacy and Concept Mastery Of Students' Buffer Solution based on the average significant n-Gain value between the control class and the experimental class. The results showed that the feasibility of the POGIL model and the activities of students had a "very high" criterion. The average value of n-Gain self-efficacy in the experimental class was 0.67 with "moderate " criteria and the average n-Gain value for mastery of the experimental class concept was 0.65 with "moderate" criteria. Based on these results, it was revealed that the POGIL model was effective in increasing self-efficacy and mastery of the buffer solution concept.

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

Abstrak: Efektivitas Model Pogil untuk Meningkatkan Efikasi Diri dan Penguasaan Konsep Larutan Penyangga. *Penelitian ini bertujuan untuk mendeskripsikan efektivitas model POGIL untuk meningkatkan efikasi diri dan penguasaan konsep larutan penyangga peserta didik. Penelitian ini menggunakan metode kuasi eksperimen dengan pretest-postest kontrol group design. Populasi dalam penelitian ini adalah seluruh peserta didik kelas XI IPA SMA Negeri 12 Bandar Lampung Tahun Pelajaran 2019/2020. Sampel dalam penelitian ini adalah kelas XI IPA 3 sebagai kelas eksperimen dan kelas XI IPA 4 sebagai kelas kontrol. Sampel dipilih menggunakan teknik cluster random sampling. Efektivitas model POGIL diukur untuk meningkatkan efikasi diri dan penguasaan konsep peserta didik pada materi larutan penyangga berdasarkan rata-rata nilai n-Gain yang signifikan antara kelas kontrol dan kelas eksperimen. Hasil penelitian menunjukan bahwa keterlakasaan model POGIL dan aktivitas peserta didik berkriteria "sangat tinggi". Rata-rata nilai n-Gain efikasi diri pada kelas eksperimen sebesar 0,67 berkriteria "sedang" dan rata-rata nilai n-Gain penguasaan konsep kelas eksperimen sebesar 0,65 berkriteria "sedang". Berdasarkan* *hasil penelitian tersebut disimpulkan bahwa model POGIL efektif untuk meningkatkan efikasi diri dan penguasaan konsep larutan penyangga.*

Kata kunci: *model POGIL, efikasi diri, penguasaan konsep, larutan penyangga*

▪ INTRODUCTION

Chemistry is one part of Natural Sciences (IPA) which studies the structure, arrangement, properties and changes of matter, and the energy that accompanies material changes that involve the skills and reasoning of students (Silberberg, 2009). Based on this, chemistry learning must be more directed at the learning process that can activate students to help students understand the concepts in chemistry learning.

In chemistry learning, students are not only required to understand chemical concepts, but students must also be able to construct the concepts they understand to solve a chemical problem (Patmi, Kadaritna, & Tania, 2015). Many students consider chemistry as a difficult subject to understand. This is due to the many complex and abstract chemical concepts that make chemistry difficult for most students to understand (Wang, 2007). The difficulty of students in studying chemistry results in students having low self-efficacy which results in unsatisfactory learning outcomes. Therefore, it requires a belief in students or self-efficacy to be able to learn abstract chemical concepts.

Self-efficacy is a person's belief in his ability to organize in carrying out a series of actions needed to achieve desired goals (Bandura, 1997). Students who have strong self-efficacy will be able to survive in difficult situations and really like challenging tasks not only in learning, so that students who have strong self-efficacy can be sure to be able to achieve and have high achievement (Harahap, 2011).

Improved chemistry learning achievement can be seen from the increase in students' mastery of concepts after learning takes place. Mastery of concepts is an activity in recording and transferring back some information from a subject matter that has been studied by students and then interpreted in real life (Silaban, 2014). Mastery of concepts is very important for students in order to capture chemistry learning material properly. One of the methods used to improve students 'mastery of concepts is by providing examples of students' daily lives from various types of situations (Slavin, 2006).

The material of the buffer solution is one of the materials whose concept is closely related to everyday life. The material for the buffer solution is found in KD 3.13, namely analyzing the role of buffer solutions in the body of living things and KD 4.13, namely designing, conducting, and concluding and presenting the results of experiments to determine the properties of the buffer solution. In this competency, students are invited to observe, try and do and answer questions related to the buffer solution material. Students are invited to think through facts or phenomena commonly found in everyday life. The learning process that involves active students in it with their initial knowledge can help students solve these problems easily so that it can increase self-efficacy and mastery of students' concepts regarding buffer solution material.

Based on the results of an interview with one of the educators in chemistry subjects at SMA Negeri 12 Bandarlampung, it was found that in chemistry learning, especially the material for the buffer solution, educators had implemented learning using the 2013 curriculum, but in practice it was not optimal because educators still tended to explain on the board and was more monotonous. Learning activities like this will make students get bored quickly, passively and only get an explanation of the material presented by the educator without involving the students themselves in finding concepts in chemistry subject matter, especially buffer solution material, so that students cannot measure the abilities they have. themselves and do not understand the concepts in chemistry subject matter. Learning like this can also be a factor in the low self-efficacy of students and students' low mastery of concepts.

The learning process of chemistry in schools will be better if the learning feels fun and leads to discovery in the process, so that the learning outcomes that will be achieved later can be useful for students. Therefore, educators must be able to take a policy, namely by improving teaching methods so that the expected learning competencies can be achieved properly, because using appropriate learning methods will be able to increase the effectiveness of learning in class. One of the learning models that can be applied in chemistry learning is to use the POGIL (Process Oriented Guided Inquiry Learning) model.

The POGIL model is a learning model that prioritizes student-centered learning to encourage active participation of students and collaborates with groups in the class so that the ability to master concepts can develop (Widyaningrum, 2016). POGIL learning emphasizes the discovery of new knowledge in the learning process of students which is carried out in groups or individually. In practice, students are faced with questions that can be used to improve problem solving, problem solving, reporting, metacognition, and individual responsibility skills. In this model, the division of tasks is carried out for each group member, so that each group member plays an active role in learning activities.

Based on this description, this article will describe the effectiveness of the POGIL model to improve self-efficacy and mastery of the buffer solution concept.

▪ METHOD

This research was conducted at SMA Negeri 12 Bandarlampung with the population in this study being students of class XI IPA at the school for the 2019/2020 school year which consisted of 5 classes. Sampling in this study was carried out randomly using the cluster random sampling technique, so that the samples in this study were XI IPA 3 as the experimental class and XI IPA 4 as the control class.

The research method used in this study was a quasi-experimental study with a pretest-posttest control group design (Fraenkel, Wallen & Hyun, 2012). The design of this study looked at the differences in pretest and posttest as well as differences in students' self-efficacy before and after treatment between the experimental class and the control class. The research design can be seen in Table 1

Table 1. Research design pretest-posttest control group design

Research Class	Pretest	Treatment	Postes
Control	O1	C	O2
Experiment	O1	X1	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 self-efficacy and students' mastery of concepts. 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 Bandarlampung to carry out the research; (2) making observations to obtain information in the form of student data, student characteristics, lesson schedules, teaching methods of chemistry educators in class, facilities and infrastructure available in schools to support the implementation of research; (3) determine the learning model to be used in the buffer solution material, namely by using the POGIL model; (4) determine the population and research sample; (5) preparing learning tools and research instruments; (6) perform the validity and reliability of the test instruments.

The procedure for the implementation stage in this study were (1) conducting a pretest with the same questions in the experimental class and the control class; (2) providing self-efficacy questionnaires at the beginning of learning in the experimental class and the control class; (3) carrying out learning activities on buffer solution material, learning using the POGIL model applied in the experimental class and conventional learning being applied in the control class; (4) make observations about the activities of students during learning; (5) make observations about the feasibility of learning using the POGIL model; (6) giving a questionnaire to students' responses to the POGIL model; (7) posttest with the same questions in the experimental class and the control class; (8) provide self-efficacy questionnaires at the end of learning in the experimental class and the control class.

The instruments used in this research are; (1) pretest and posttest questions in the form of concept mastery questions on the buffer solution material; (2) students' self-efficacy questionnaire adopted from Sunyono (2015); (3) student questionnaire responses to the POGIL model on the buffer solution material; (4) student activity observation sheet; (5) the observation sheet for the implementation of learning using the POGIL model.

Data management using Microsoft Excel and analysis using SPSS Statistic 17.0. The steps for managing the data on the self-efficacy questionnaire were (1) coding or classifying the data; (2) tabulating the data based on the classifications made; (3) give a score for the respondent's answer. The self-efficacy questionnaire scores are as follows:

Table 2. Scoring on the Self-Efficacy Questionnaire

No	**Answer Options**	**Scoring Scale**	
		Positive Statement	**Negative Statements**
1	SL (always)	3	1
2	KD (sometimes)	2	2
3	TP (never)	1	3

(4) processing the number of scores of respondents' answers. (5) converting the answer score into a value using the following formula:

$$\%X_{in} = \frac{\sum S}{S_{maks}} \text{ x } 100\%$$

(6) calculating n-Gain with the following formula:

$$n\text{-}Gain = \frac{\text{final self−efficacy score − initial self−efficacy score}}{100 - baseline\ self-efficacy\ score}$$

(7) interpret the mean overall value of n-Gain self-efficacy using the following criteria:

Table 3. Criteria for the n-Gain value (Hake, 2002)

n-Gain	**Criteria**
> 0,7	High
0,3 < n-Gain ≤ 0,7	Moderate
n-Gain ≤ 0,3	Low

The steps of managing the pretest posttest data on the mastery of the students' concepts regarding buffer solutions are (1) changing the score into a value with the following formula:

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

(2) calculate n-Gain. This calculation aims to determine the increase in the pretest and posttest scores of the two classes. The calculation of the n-Gain value is calculated using the following formula:

$$n\text{-}Gain = \frac{postest\ value - pretest\ value}{the\ maximum\ value - pretest\ value}$$

(3) interpret the criteria for the average n-Gain value for mastery of the concept by using the criteria from (Hake, 2002)

Table 4. Criteria for the n-Gain value (Hake, 2002)

n-Gain	**Criteria**
> 0,7	High
0,3 < n-Gain ≤ 0,7	Moderate
n-Gain ≤ 0,3	Low

After processing the data, an analysis of the n-Gain value obtained was carried out using SPSS version 23.0 to obtain normality, homogeneity, and the difference between the two mean self-efficacy 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 two mean difference test was carried out by using the independent sample t-test of the mean n-Gain value of self-efficacy and the mastery of the concepts of students in both samples. Based on the test results of the difference between the two mean self-efficacy and students 'mastery of concepts, the effect size calculation is then carried out to determine how much influence the POGIL model has to increase self-efficacy and mastery of the students' 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

Validity and Reliability Test

Analysis of the validity and reliability of the test instruments in the form of self-efficacy questionnaires and concept mastery pretest-posttest questions were carried out using SPSS 17.0 software which was determined by comparing the rcount and rtabel values. The value of rhitung is obtained from the calculation using SPSS version 17.0 software, while the value of r_{tabel} (product moment) is obtained from the table of the critical value of the distribution of r with n = 20 and the significance level = 5%, the r_{tabel} value is 0.444. The test instrument is said to be valid if the value r_{count}> r_{tabel}. Based on the results obtained, the self-efficacy questionnaire and the concept mastery pretest-posttest showed that r_{count}> r_{table}, so it was declared valid and could be used in research to measure students' self-efficacy and conceptual mastery.

The reliability of the instrument was determined using the Alpha Cronbach formula by comparing the r_{11} and r_{table} values. The test instrument is said to be reliable if r_{11}> r_{tabel}. The results of the calculation on the self-efficacy questionnaire obtained cornbach alpha of 0.960 with the reliability criteria "very high", while the calculation on the pretest-posttest questions of concept mastery obtained cornbach alpha of 0.839 with the reliability criteria "very high". This shows that r_{11}> r_{table}, so that the self-efficacy test instrument and concept mastery are declared reliable and can be used in research to measure students' mastery of concepts.

Student Activity Data Analysis

The results of the analysis of the activities of students in the two classes are presented in Table 5 showing an increase in the activity of students at each meeting. The activities of students include paying attention when learning takes place, engaging in group discussions, taking an active role in group discussions, answering questions posed by educators correctly, incorporating new ideas into the knowledge they have previously had when answering or asking questions, following learning with high enthusiasm and actively involve in the learning process.

Table 5 shows that the average activity of students in the control class is 55.17% with the "moderate" criteria and in the experimental class that applies learning with the POGIL model the average activity of the relevant students is 74.64% with the criteria " high". This shows that learning with the POGIL model can make students' interest in learning higher than learning that does not use the POGIL model in the buffer solution material.

Table 5. Data on student activity in learning activities.

Meeting	Percentage of student activity (%)	
	Control Class	Experiment Class
1	47,14	59,28
2	52,14	71,43
3	56,42	80,71
4	64,99	87,14
Average	55,17	74,64

Student Response Data Analysis

Student responses to learning using the POGIL model are measured using a student response questionnaire given at the end of the meeting. Student response data are presented in Figure 1.

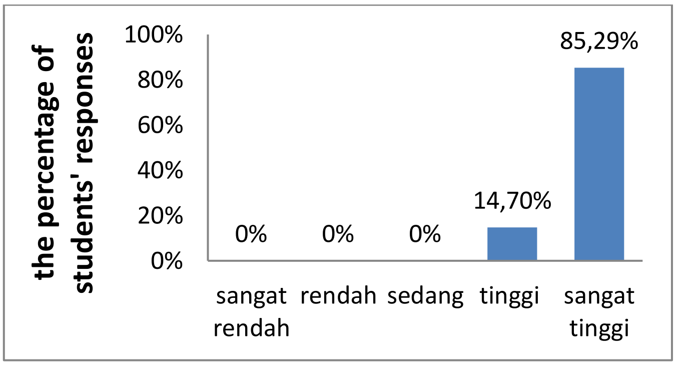

Figure 1. The percentage of students' responses to the POGIL model

Based on the graph in Figure 1, it can be seen that the response of students with "high" criteria has a percentage of 14.70% and "very high" criteria of 85.29%. This shows that the POGIL model is very good to use during learning.

POGIL Model Implementation Data Analysis

The POGIL model implementation sheet that has been assessed by the observer is used to measure whether educators have applied the POGIL model during the learning process and assess how the educator's efforts to increase self-efficacy and students' mastery of concepts. The results of data analysis on the implementation of the POGIL model are presented in Table 6.

Table 6. Results of data analysis on the implementation of the POGIL model

Observational Aspects	**Percentage of Educator Ability at Meeting (%)**				**Average**
	1	**2**	**3**	**4**	
preliminary	68,75	81,25	84,38	93,75	82,03
Orientation	62,5	75	81,25	87,5	76,56
Exploration	68,75	75	84,38	90,63	79,69
Concept Discovery	59,38	68,75	81,25	87,50	74,22
Application	75	81,25	93,75	100	87,5
Closing	75	81,25	81,25	93,75	82,81
Assessment of Educators	65	75	85	90	78,75
Average	67,76	76,78	84,46	91,87	80,22
Interpretation of Criteria	Tinggi	Tinggi	Sangat Tinggi	Sangat tinggi	Sangat Tinggi

Based on Table 14, it can be seen that the percentage of implementation of the POGIL model has increased at each meeting, where at the first meeting of 67.76% with "high" criteria, the second meeting of 76.78% with "high" criteria, the third meeting of 84.46% criteria "Very high" and the fourth meeting of 91.87% has the criteria of "very high". Overall the average value of the implementation of the POGIL model is 80.22% with the criteria "very high", which means that educators have implemented the POGIL model well in the learning process in the experimental class.

Self Efficacy

The self-efficacy of students was measured using a self-efficacy questionnaire containing 36 statements, consisting of 18 favorable statements and 18 unfavorable statements. The self-efficacy questionnaire includes three indicator aspects, namely magnitude, strength, and generality. Self-efficacy data in the control class and experimental class are presented in Table 7.

Table 7. Student self-efficacy questionnaire data in learning activities.

No	Self-Efficacy Aspects	Control			Experiment		
		Pretest	**Postes**	***n-Gain***	**Pretest**	**Postes**	***n-Gain***
1	Magnitude	64,99	79,26	0,41	62,55	87,50	0,67
2	Strength	66,10	78,76	0,37	60,54	85,87	0,64
3	Generality	60,29	75,49	0,38	62,26	88,97	0,71
Average		63,79	77,84	0,39	61,78	87,45	0,67
Criteria				**Moderate**			**Moderate**

Based on Table 7, it can be seen that the mean value of self-efficacy pretest in the control class is 63.79, while the average self-efficacy pretest score in the experimental class is 61.78. The average post-test self-efficacy score in the control class increased by 77.84, while the average post-test self-efficacy score in the experimental class was 87.45. Based on the data from the pretest and posttest self-efficacy questionnaire, calculations were made with the n-Gain formula, so that the average n-Gain value of all aspects in the control class was 0.39 with the criteria of "moderate" and in the experimental class was 0.67 with criteria "moderate". This shows that the average n-Gain value of students in the experimental class was higher than the average n-Gain value of students in the control class. This shows that the increase in self-efficacy of experimental class students is better than the control class.

The self-efficacy of students in both classes increased in all aspects of magnitude, strength, and generality, but it can be seen that the increase in the experimental class was higher than in the control class. The increase in the magnitude aspect can be seen during the learning process from the first meeting to the last meeting, where students are more active, focused and enthusiastic in working on the LKPD given by the educator. Izzati, Sunyono & Efkar (2015) state that this indicates that students have a high level of confidence in facing problems and assignments at LKPD.

The stress aspect increases during the learning process from the next meeting to the next, where students continue to work on questions and discuss. Students still persist in solving problems with a difficulty level that is classified as difficult even though the answers are less than perfect. Then students are willing to express the opinions of their groups, even though their opinions are not always right or close to being perfect. Izzati, Sunyono & Efkar (2015) state that this shows students are not easily affected by the environment which affects the strength of their belief in their abilities, so that students have resilience and tenacity in learning chemistry.

The increase in generality aspects can be seen in the question and answer process that takes place, students express opinions from each group and other groups comment on the opinions of other groups, it can be seen that each student is very active in asking or responding to the LKPD answers from the percentage groups. Izzati, Sunyono & Efkar (2015) state that the increase in this aspect shows that students are able to display their learning activities not only limited to certain chemical learning activities, but also spread to various other chemistry learning activities.

Based on these results it can be stated that learning using the POGIL model has an effect in increasing the self-efficacy of students in the buffer solution material.

Mastery of Concepts

Mastery of concepts is measured by using the test questions for mastery of the concept of the buffer solution material which consists of 10 essay questions. Students' mastery of concepts in this study can be demonstrated through the results of working on the concept mastery test questions given at the beginning and at the end of the lesson. The increase in concept mastery is shown through the n-Gain value, which is the difference between the post-test and pretest scores, and is calculated based on the formulas and criteria proposed by Hake (2002). The results of the concept mastery data analysis are shown in Figure 2.

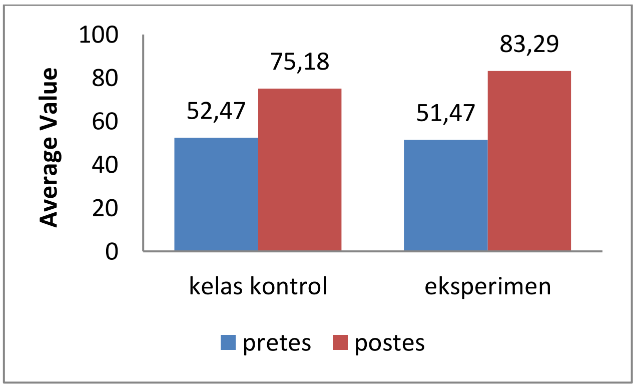

Figure 2. The average value of the pretest and posttest students' concept mastery of the control class and the experimental class

Based on Figure 2, it can be seen that in the control class the average pretest score is 52.47 and the average post-test score is 75.18, while in the experimental class the average pretest score is 51.47 and the average post-test score after being applied learning using the POGIL model is 83.29. This shows that the increase in the average value of students 'concept mastery in the experimental class that is applied to learning using the POGIL model is higher than the average value of students' concept mastery in the control class where the POGIL model is not applied in their learning. This increase in the average n-Gain value shown in Figure 3.

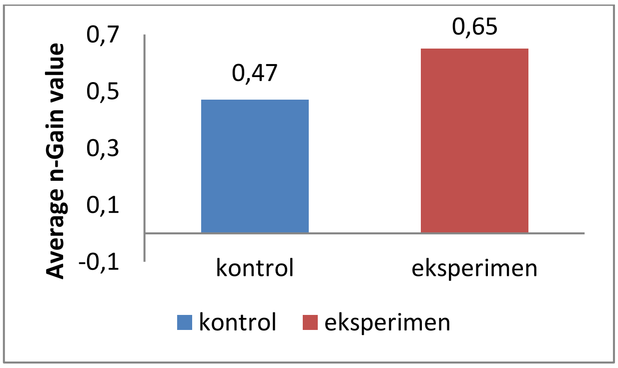

Figure 3. The average *n-Gain* value of the control class and experimental class students' concept mastery

Based on the average n-Gain value shown in Figure 3, the average n-Gain value obtained in the control class is 0.47 with the criteria of "moderate" and the average n-Gain value obtained in the experimental class is equal to 0.65 with "moderate" criteria. Even though they have the same criteria, the average n-Gain value of concept mastery in the experimental class is higher than the average n-Gain value of concept mastery in the control class. This shows that the POGIL model is more effective in increasing students' mastery of the concepts of the buffer solution material.

Hypothesis test

Hypothesis testing in this study was carried out by means of normality test, homogeneity test and two mean difference test. The results of the normality test on the *n-Gain* value of students' self-efficacy in the control class and experimental class are presented in Table 8.

Table 8. The results of the *n-Gain* normality test for students' self-efficacy

Class	**N**	**Information**	
		Sig value.	**Test Criteria**
Control	34	0,200	Sig. > 0,05
Experiment	34	0,200	Sig. > 0,05

Based on Table 8, it is known that the results of the *n-Gain* normality test for students' self-efficacy in the control class obtained a sig value. 0.200 and in the experimental class the sig value is obtained. 0.200. This shows that the results of the normality test that have been carried out in both classes have a *sig*.> 0.05, so the decision to accept H0 and reject H1 means that the research data obtained is normally distributed.

The results of the normality test on the *n-Gain* value of students' concept mastery in the control class and experimental class are presented in Table 9

Table 9. The results of the n-Gain normality test for students' mastery of concepts

Class	**N**	**Information**	
		Sig value.	**Test Criteria**
Control	34	0,200	Sig. > 0,05
Experiment	34	0,200	Sig. > 0,05

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Based on Table 9, it is known that the results of the *n-Gain* normality test for the mastery of the concept of students in the control class obtained the sig value. 0.200 and the results of the normality test for the experimental class obtained the sig value. 0.200. This shows that the results of the normality test that have been carried out in both classes have a *sig*.> 0.05, so the decision to accept H_0 and reject H_1 means that the research data obtained is normally distributed.

The results of the homogeneity test of students' self-efficacy data in the control class and experimental class are presented in Table 10.

Table 10. The results of the n-Gain homogeneity test for students' self-efficacy

Class	N	Information	
		Sig value.	**Test Criteria**
Control	34	0,129	Sig. > 0,05
Experiment	34		

Based on Table 10, it is known that the results of the homogeneity test on the *n-Gain* value of students' self-efficacy in the control class and experimental class obtained a sig value of 0.129. This shows that the results of the homogeneity test that have been carried out in the two classes have a *sig*.> 0.05, so the decision to accept H_0 and reject H_1 means that the research data obtained comes from homogeneous variance.
The results of the homogeneity test of students' concept mastery data in the control class and experimental class are presented in Table 11

Table 11. The results of the *n-Gain* homogeneity test of students' mastery of concepts

Class	N	Information	
		Sig value.	**Test Criteria**
Control	34	0,191	Sig. > 0,05
Experiment	34		

Based on Table 11, it is known that the results of the homogeneity test on the n-Gain value of students' concept mastery in the control class and experimental class obtained a sig value of 0.191. This shows that the results of the homogeneity test that have been carried out in the two classes have a *sig*.> 0.05, so the decision to accept H_0 and reject H_1 means that the research data obtained comes from homogeneous variance.
The results of the test for the difference between the two mean *n-Gain* values of students' self-efficacy are presented in Table 12.

Table 12. The test results of the difference between the two mean *n-Gain* students' self-efficacy

Class	N-Gain average	N	Information	
			sig. *(2-tailed)*	**Test Criteria**
Control	0,40	34	0,00	sig. *(2-tailed)* < 0,05
Experiment	0,67	34		

Based on Table 12 shows that the sig. (2-tailed) of the t-test for equality of means <0.05 so that the decision to accept H_0 and reject H_1, which means that there is a significant difference in the mean value of *n-Gain* self-efficacy in the control class and the experimental class. The average *n-Gain* value of students' self-efficacy in the experimental class that was applied to the POGIL model was higher than the average n-Gain value of students in the control class that was applied to the conventional model on the buffer solution material.

The results of the two difference test mean *n-Gain* values for students' concept mastery are presented in Table 13.

Table 13. The test results of the difference between the two *n-Gain* mean of students' mastery of concepts

Class	N-Gain average	N	Information	
			sig. (2-tailed)	Test Criteria
Control	0,47	34	0,00	sig. *(2-tailed)* <0,05
Experiment	0,65	34		

Based on Table 13, it shows that the sig. (2-tailed) from the t-test for equality of means <0.05 so that the decision to accept H_0 and reject H_1, which means that there is a significant difference in the average *n-Gain* value of concept mastery in the control class and the experimental class. The average *n-Gain* value of students 'concept mastery in the experimental class applied to the POGIL model was higher than the n-Gain value of students' concept mastery in the control class that was applied to the conventional model on the buffer solution material.

The results of the POGIL model effect size test in increasing the self-efficacy of student buffer solutions are presented in Table 14.

Table 14. Results of the effect size test on the ability of self-efficacy

Class	t	t^2	*Df*	μ	Criteria
Control	-9,216	84,934656	70	0,74	Great effect
Experiment	-19,094	364,580836	70	0,91	Great effect

Based on Table 14, it shows that the effect size of self-efficacy obtained in the experimental class is 0.91 with the criteria for "big effect", while for the control class it is 0.74 with the criteria for "big effect". The effect size obtained shows that 91% of students 'self-efficacy is influenced by learning using the POGIL model, while 74% of students' self-efficacy is influenced by learning with conventional models. The results of these calculations indicate that the effect of the POGIL learning model in the experimental class is greater than the control class on increasing the self-efficacy of students on the buffer solution material.

The results of the POGIL model effect size test in increasing the students' mastery of the buffer solution concept are presented in Table 15.

Table 15. Results of the effect size test on concept mastery ability

Class	t	t^2	*Df*	μ	Kriteria
Control	-13,578	184,362084	66	0,86	Efek besar
Experiment	-23,732	563,207824	66	0,95	Efek besar

Based on Table 15, it shows that the effect size of concept mastery obtained in the experimental class is 0.95 with the "big effect" criteria, while for the control class it is 0.86 with the "big effect" criteria. The effect size obtained shows that 95% of students 'mastery of concepts is influenced by learning using the POGIL model, while 86% of students' mastery of concepts is influenced by conventional learning. The results of these calculations indicate that the effect of the POGIL learning model in the experimental class is greater than the control class on the increase in students' mastery of concepts on the buffer solution material.

▪ CONCLUSION

Based on the results and analysis of research data, it is concluded that the POGIL model is effective in increasing self-efficacy and students' mastery of concepts in the buffer solution material. This can be shown through the significant difference between the *n-Gain* value in the experimental class and the control class, where the experimental class has an average n-Gain value that is greater than the control class.

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