Implementation of The Problem-Based Learning which Combined with Group Investigation in Physics to Improve the Student's Learning Outcomes

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ABSTRACT

This research is a pre-experimental study which aims to determine the physics learning outcomes of class XI students at public high school 1 Bantaeng using Problem-Based Learning method combined with the Group Investigation Method. We obtained the data through pretest and posttest. The sample in this study was selected using purposive sampling. where the sample consists of one class with 15 people. The results of the descriptive research indicate that there is an increase in student learning outcomes after the method has been implemented. This is proved by the t-test which shows obtained result to be 22,031 where the t table obtained is 1.7613.

INTISARI

Penelitian bersifat pra-eksperimen yang bertujuan untuk mendapatkan hasil belajar fisika dari kelas XI di SMA Negeri 1 Bantaeng menggunakan metode Problem-Based Learning yang dikombinasikan dengan metode Group Investigation. Data yang didapatkan dalam penelitian ini berasal dari pretes dan postes. Sampel dari penelitian ini berjumlah 15 orang. Hasil dari penelitian deskriptif ini adalah adanya peningkatan hasil belajar fisika setelah pemberian methode tersebut. Ini dibuktikan dari uji hipotesis dari t-test yaitu 22.031 sedangkan t-table terhitung 1.7613.

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A. Introduction

Learning outcomes are defined by the improvement of mental growth [1]. The learning outcomes can be investigated from the result of the evaluation test. These outcomes strongly depend on the teaching method, curriculum, relation between teacher and students, and discipline implemented by the school [1].

To improve the learning outcomes, many methods have been developed. One of the famous methods is Problem-Based Learning (PBL). The basic idea of PBL is developing the problem which can be used as the starting point to obtain the

knowledge [2]. This model encourages students to learn based on daily problems connected with the upcoming knowledge. However, the other research found that in PBL, students tend to get lazy to solve problems by themselves [3]. Hence, the PBL method should be combined with another method called Group Investigation (GI) to enhance the process. The challenge with this method is the combination needs cooperation between students [4] Thus, the key to this method lies in how students cooperate. For further discussion, we will call this combination between PBL and GI to be PBL-GI to simplify.

In PBL-GI, each task should be pointed out to give a chance for a group's member to show their contribution. It is possible that learning outcomes for each group member are obtained once the group obtained its outcomes [5], [6]. This way, the student's growth can be improved through collaborative work inside the group.

The preliminary observation has been done in Public High School 1 Bantaeng, South Sulawesi, Indonesia. In this observation, we obtain some problems corresponding to the learning outcome of the students. With a lack of motivation to study on their own resulting in them being mostly below the minimum score, it is better to resolve the problem by constructing a method that allows the students to learn in a group. Thus, it is understandable that GI is favoured by such conditions. Also, PBL is necessary to attract the student to work in a group.

B. Method

This research uses Pre-Experiment Design method also it is designed to be one group pretest-posttest with twice observations that have been used. Both observations occur at the pretest and the other is by posttest. Between pretest and posttest, there is some kind of treatment where PBL-GI occurs. In this research, we observed 15 samples in one of class XI. PBL-GI is applied here by using observation sheets for both teacher and students to observe the conditions during the class. The indicators for teachers on the observation sheets consist of the syntax of the learning method/model, the utilization of teaching media, learning source, scoring, and languages used in the teaching. For students' observation sheets consist of the implementation of the model/method and the utilization of teaching sources.

The descriptive analysis technique has been used in this paper. Thus, describing and giving some clues about the object based on the sample or population and deriving them into general cases [7]. We also describe the score of all variables in this research by using the descriptive analysis technique. Lastly, we used preliminary tests which consist of normality, variance homogeneity, and hypothesis tests.

C. Result and Discussion

The research has been done to get the result on the implication of the PBL-GI model. In the preliminary, we obtain the frequency distribution test on the student. We obtain the data of descriptive analysis which purposely gives the learning

outcome. It contains the highest score, lowest score, average score, standard deviation, and variance. One can see Table 1 for details.

Table 1. The Frequency Distribution of Pretest Before Imbued by PBL-GI

Score (X_i)	Frequents (f_i)
38	1
40	1
45	1
46	1
53	2
55	1
57	1
60	1
65	1
70	1
71	1
74	1
75	1
Total	15

Data from Table 1 became the reference for the descriptive analysis of the data. Therefor the descriptive analysis of Table 1 could be seen in Table 2.

Table 2. Data of the learning outcomes of the class before PBL-GI is applied.

Descriptive analysis	Pretest
Number of Sample	15
Max	75.00
Min	38.00
Mean	55.400
Range	37.00
Standard Deviation	12.14672
Variance	147.543

Based on Table 2, the maximum score obtained during the pretest is 75.00, with a minimum of 38.00 and a range of 37. The average value obtained based on the scores is 55.40 with a standard deviation of 12.14672 and a variance of 147.543. The learning output categories with their range we put in this research can be seen in Table 3.

Table 3. The Learning Output Categories After Pretest

No.	Range	F	%	Category
1.	85 – 100	0	0	Very High
2.	65 - 84	5	33.4	High
3.	55 - 64	4	26.6	Medium
4.	35 – 54	6	40	Low
5.	0 – 34	0	0	Very Low
	Total	15	100	

In the pretest we obtain the data corresponding scores which are depicted in Figure 1. In Figure 1 the pretest score in category "high" is obtained by 5 students, "medium" for 4 students, and 6 more students obtain "low" result.
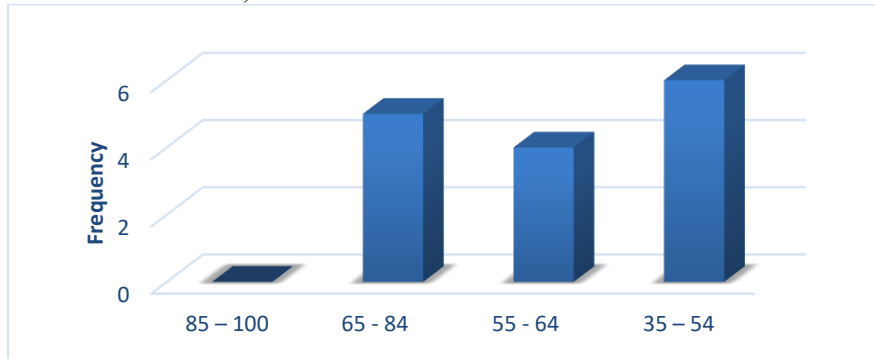

Figure 1. Histogram of Pretest Categorization of Learning Outcomes

After PBL-GI is applied to the students, we obtain some data based on the post-test. The result could be presented in Table 4.

Table 4. Frequency distribution after posttest which is implemented by the PBL-GI method

Score (X_i)	Frequents (f_i)
79	2
80	1
83	1
84	1
85	4
87	1
88	2
90	**3**
Total	**15**

For further information, we obtain the data corresponding to the scores on the post-test result from the students. We describe the result in Table 5. There are some improvements which are depicted in the results. Especially on the minimum result which is enhanced so much compared to the pretest score.

Table 5. Data of the post-test result after implementation of PBL-GI

Descriptive analysis	Pretest
Number of Sample	15
Max	90.00
Min	79.00
Mean	85.2000
Range	11.00
Standard Deviation	3.76450
Variance	14.171

We also categorize the scores after the post-test which can be shown in Table 6. The range of those scores has been improved with no student obtaining the "low" result. Also, 10 students could achieve the "very high" result with a range of 85-100.

Table 6. The learning output categories after posttest

No.	Range	F	%	Category
1.	85 – 100	10	66.6	Very High
2.	65 - 84	5	33.4	High
3.	55 - 64	0	0	Medium
4.	35 – 54	0	0	Low
5.	0 – 34	0	0	Very Low
	Total	**15**	**100**	

In Figure 2 we clearly show the corresponding result on the histogram. This way we can compare the result from Figure 1.
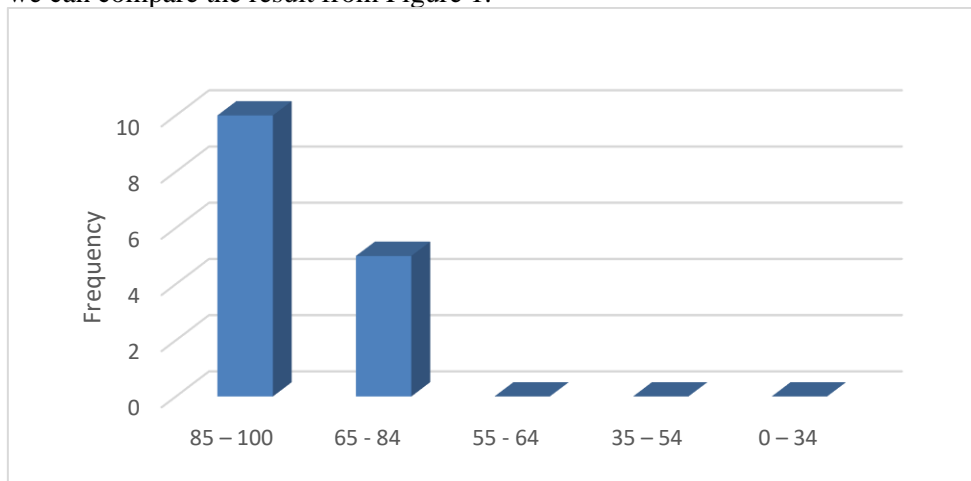

Figure 2. Histogram of Posttest Categorization of Learning Outcomes

We see the difference between pre-test and post-test. In addition, we obtain the result based on the t-test which is 20.031, and sig(2-tailed) under 0.05 which is 0.00. It means we can use PBL-GI on the subject.

On the statistical inference, we used normality, homogeneity, and hypothesis tests which we presented as follows.

Normality test

a. Normality test before PBL-GI implementation

Table 7. Normality test before PBL-GI implementation with SPSS

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
Score	.114	15	.200*	.947	15	.473

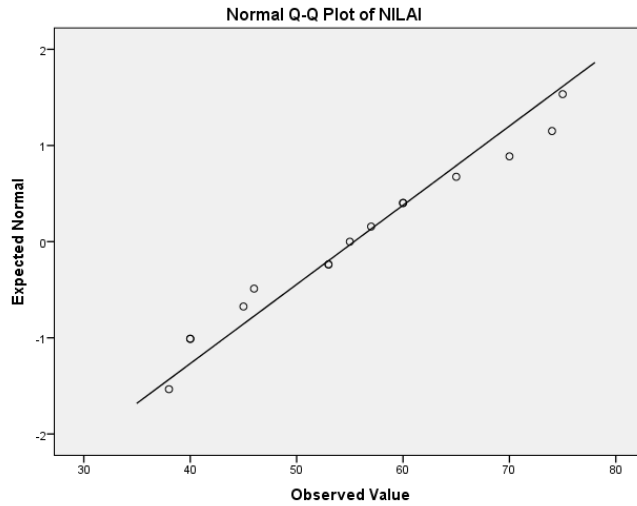One could also be seen in Figure 3 for further information corresponding to the result.

Figure 3. The normal QQ plot of the pretest

b.   The Normality test after posttest

Table 8. Normality test after posttest

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	Df	Sig.	Statistic	Df	Sig.
NIL AI	.145	15	.200[*]	.912	15	.146

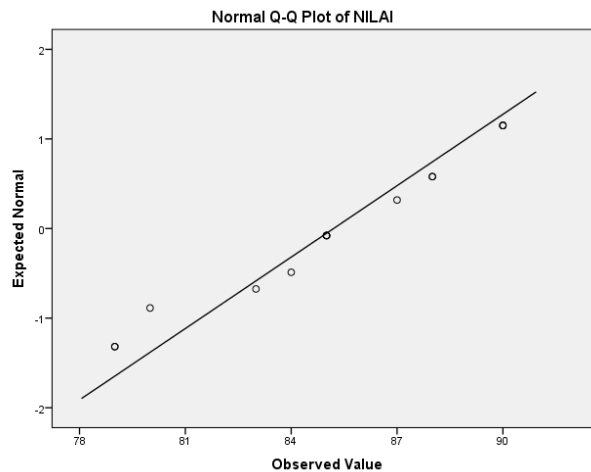One could also see the in Figure 4 for further information corresponding to the result.

Figure 4. The normal QQ plot of the posttest

Homogeneity test

The homogeneity in this research is using SPSS with *Lavene Statistic* with significant $\alpha = 0,05$ with variation analysis before and after PBL-GI. If the significant score is more than 0,05, the variance for every sample is the same. Thus, our sample is shown to be homogenous based on the test, see Table 9 for further information.

Table 9. Result of the homogeneity test.

Levene Statistic	df1	df2	Sig.
13.923	1	28	.067

Hypothesis Test

Even if our result shows an improvement in post-test from the pre-test result. A hypothesis test is needed to confirm that there is an improvement after the PBL-GI method. With the normality test shown to be "normal" and with the homogeneity test the sample shown to be "homogenous", we can use paired t-test to do the hypothesis test.

Table 10. t-test result

	Paired Differences					t	Df	Sig. (2-tailed)
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
PRE TEST-POSTTEST	68.80	17.10495	3.12292	62.41291	75.18709	22.031	29	.000

Based on the hypothesis result we obtain t=22.031 which is much larger than ttable = 1.7613, which means H0 is refused and H1 is accepted. Thus, PBL-GI can be considered to make an impact on the improvement of learning outcomes.

We investigated, based on the result and also the progress during the implementation of PBL-GI, there is a major impact on this model. By aligning the students into the group, the students' growth of knowledge can be improved together since there is a collaboration between the students when learning. They learn how to solve the problem together and actively make a decision together by sharing their opinions. This is also the advantage of the GI method. In addition, giving the problem to students also could enhance their ability to the critically thinking which is the characteristic of PBL. This combined method: PBL-GI is shown to be effective in improving the students' learning outcomes.

Despite the advantages of this model, there are some difficulties when applying this model. First, teachers should be more effort to make a creative problem-solving with their students. Second, we found the students themselves should be at least capable to understand the problem. Third, we also found every student who implemented this model should be able to communicate with other students. Fourth, extra time is needed, thus the teacher should accommodate such difficulties. However, based on the three problems we mentioned, the teacher should make sure that the class is ready to be implemented by PBL-GI model.

D. Conclusion

The research of the PBL-GI model in public high school of class XI Bantaeng, South Sulawesi, Indonesia has been done. We have shown that PBL-GI could give the improvement on the students' learning outcomes. The improvement of the students' outcomes could be identified by the improvement of students' results by group. It means the corresponding group's result could improve each member's result. This improvement has been tested by the t-test to show the effect of PBL-GI on the implementation of the learning.

During the research, we found that PBL-GI came with a great challenge for both teachers and students. in teachers, it would make more burden teachers, since extra creativity is needed to perform PBL-GI. Also, cooperation between students plays a crucial role. Lastly, this PBL-GI is time-consuming, thus finally it strongly depends on the teacher to perform such a method.

Acknowledgments

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