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Investigating the Effectiveness of Inquiry Learning and Direct Learning Models toward Physics Learning

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***Abstract*—This research proposes to determine the effectiveness of physics learning by comparing physics learning models, namely inquiry learning and direct learning models. This research limited to a review of student learning outcomes taught by using inquiry learning and direct learning. The research instrument consisted of a learning program plan, questions, and worksheets for students with a research period of 5 months. The topic taught of static fluid in class XI of Senior High School 1 Lawa, West Muna regency.This study used a pre-test post-test control group design where this design involved two groups of subjects, one was given experimental treatment (experimental class) and one was not treated (control class). This design consists of three phases: pre-test, application of learning models, and post-test learning. The first phase of pretest learning was tested for initial knowledge. Second phase learning is taught using two learning models in two different classes, namely the inquiry learning model and direct learning model.The third stage of the post-test stage is useful to determine the final ability of students after being taught using inquiry and direct learning in the control class and experimental class. Data analysis techniques use N-gain value. The final test results with the inquiry learning model of students included in the high category (56%), moderate (44%), and low class (0%), while in the final test the direct learning model was (20%) in the high class, (52 %) in the medium category, and as much (28%) in the low class.The conclusions of the study concluded that final tests using inquiry learning were higher than using direct learning with the percentage of effectiveness of 98.37% inquiry learning and 43.37% direct learning.**

Keywords—Inquiry learning, direct learning, Learning outcomes, physics learning

I. INTRODUCTION

The problem faced today in the field of education is low student learning outcomes. From year to year, the value of student learning outcomes is always up and down especially on physics subjects with static fluid topics, such as those occur in senior high school 1 Lawa in West Muna regency. Based on observations and interviews that the learning outcomes of students grade XI are not optimal. From the observations, student learning outcomes in physics subjects indicated that the average value of students in the fluid topic for the 2016/2017 school year is still relatively low, which is an average value of ≤ 65, especially in a static fluid topic. The represents that the average value of students is not by the minimum standards criteria was set by the school is 70. Moreover, this is a problem that must be resolved or sought a solution..

At present many learning models have been implemented in schools [1]. But it has not a significant influence to improve student learning outcomes, especially on the topic of the static fluid topic [2-3]. This problem is because the use learning model used tends to be monotonous and uses conventional learning models [4]. Essentially all learning processes are teacher-centred, students only accept material without knowing the origin of a given problem [5]. Furthermore, the results of the interview informed that during the learning process of physics, especially static fluid topic, the teacher merely conveyed the topic without conducting experiments or investigation that teachers tend to dominate learning activities in the classroom wherein the implementation of learning. The teacher plays an active role and does not directly involve the activities of students that students attend to be passive in receiving information, teacher knowledge and skills. While on the other hand, physics lessons on the topic of static fluid are not enough to theorise but must support by an experimental process.

The learning model used by the teacher is very influential on the effectiveness of learning because the model used the teacher is closely related to the achievement of learning objectives, namely learning outcomes [6-7]. Therefore, the selection of the wrong learning model will make the effectiveness of learning decline; there needs to be attention to the approach the teacher uses in learning. In this study, the researcher offered a model of learning inquiry and direct learning models. Researchers assume that in the learning process later students will actively conduct a study either experimentally or through literature studies with the aim to solve problems and solve problems given by the teacher..

Inquiry learning is a learning model, or students find themselves about the concepts of the material studied. [8]. Inquiry learning model expected to help students develop intellectual and skills to provide opportunities for students to get answers to a problem by finding themselves through investigations that follow scientific procedures [9-10]. While the direct learning model is one of the teaching approaches specifically designed to support student learning processes related to declarative knowledge and well-structured procedural knowledge that can teach with a regular pattern of activities, direct learning divided into five phases, namely (1) Outlines the objectives and prepare students, (2) Demonstrate knowledge and skill, (3) Guiding training, (4) Check to understand and provide feedback, and (5) Provide opportunities for advanced training and implementation [11].

Some researchers have conducted that there was a significant difference between the average score of the final test of the experimental class and the control class at the 0.05 level [12]. From the test results, terminated that the inquiry-based learning can improve learners' mastery of concepts compared to the usual learning (talk and notes) and Inquiry-based learning can improve students' science process skills. This argument is to reinforce [13] that the amount contribution given competent skills to mastering the concept of static electricity in class IX students of the Junior High School 1 Kendari was 75.97%. Whereas [14] explains that the ability of students to master aspects of independent skills can develop through inquiry-based physics learning.

Therefore, researchers are interested in researching the theme of investigating the effectiveness of inquiry learning and direct learning models on physics learning outcomes, with the purpose of acknowledging the effectiveness of physics learning by comparing two physics learning models, namely inquiry-based learning models and direct learning models. But the limitation of the problem in this study is that learning is carried out with inquiry learning models (experimental class) and direct learning models (control classes), the material studied is static fluid, this study reviews the effectiveness aspects of learning models seen from learning outcomes and participants students are limited to class XI of Senior High School 1 Lawa.

II. RESEARCH METHODOLOGY

A. *Type and Design Research*

This type of research is quasi-experimental. This research was conducted at Senior High School 1 Lawa in class XI IPA_2 (control class) and XI IPA_5 (experimental class) with a total of 25 students. The design used was a pre-test post-test control group design [15]. In detail the design of the pretest-posttest control group design can be seen as follows.

$$R = O_1 \quad X \quad O_2$$
$$R = O_3 \quad - \quad O_4$$

Where,

R : Random sampling

X : Treatment in the experimental class

O_1 : Pretest experimental class using inquiry learning

O_2 : Posttest experimental class using inquiry learning

O_3 : Pretest control class using direct learning

O_4 : Posttest control class using direct learning

B. *Research procedure*

The steps that used in this research include the following: (1) a survey in research location to know the condition of the school, the amount of population that will become a research object, and the state of laboratory, (2) Arrange the teaching administration such as syllabus, lesson plan, and student worksheets, (3) Make a grid test for the trial instruments, (4) Arrange the trial instruments based on the grid that arrange, (5) Examine the trial instruments in the class XII IPA which had previously been taught the material about static fluid, (6) Analyze the result data of trial instruments in the experimental class to know the level of difficulty, question differentiator potency, question validity, and questionable reliability, (7) Decide the test questions which uses in the final test in the inquiry learning and control that meet the requirements based on data, (8) Decide the research sample, (9) Carry out the first test for the sub-material of static fluid to students in the inquiry learning and students in the direct lore, (10) Do learning with inquiry learning model for the inquiry learning and direct learning four meetings for each, (11) Conduct the final test for students learning achievement in the inquiry learning and direct learning, (12) Analyze the result of learning test and compile the reports of the research result.

C. *Data Analysis Technique*

Data were analyzed using descriptive statistical analysis includes determining the average class value, standard deviation and determining the N-gain value. To determine the value of N-gain using equation (2).

$$N_{gain} = \frac{S_{posttest} - S_{pretest}}{S_{\max -} S_{pretest}} \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}} \quad (1)$$

Where,

$S_{posttest}$: Final test score

$S_{pretest}$: Initial test score

S_{max} : Ideal maximum score

N_{gain} (normalized gain) is interpreted to state the learning outcomes of students' static fluid subject matter as in Table 1 [16].

TABLE I. Criteria for N-gain value

Range	Criteria
$N_{gain} \geq 0,7$	High
$0,3 \leq N_{gain} < 0,7$	Medium
$N_{gain} < 0,3$	Low

III. RESULT AND DISCUSSION

The description of the data in this study is in the form of data about the initial test and the final test of student learning outcomes, both students with inquiry learning and students with direct education. This study also described the improvement of learning outcomes (N-gain) of students, both with inquiry learning models and direct learning models. The results of the descriptive analysis of learning outcomes see in Table 2.

TABLE II. Data analysis of student physics learning outcomes on inquiry learning and direct learning

Value	Initial tests of Inquiry learning	Final test of inquiry learning	Initial test of direct learning	Final test of direct learning
Average	43.13	85.56	52.52	75.3
St. Deviation	18.69	8.48	12.29	10.92
Maximum	82.6	100	78.26	91.3
Minimum	17.39	69.56	30.43	52.17

To find out that the inquiry learning model is a learning model that can make students experience their knowledge when compared with direct learning models. It can be known the comparison between the two models; then before and after learning a test of learning, results is conducted to find out the differences in the increase in learning outcomes of students and the effectiveness between inquiry learning models and direct learning models. Based on the initial test data, the results of the study showed that the learning average in class XI IPA_2 which taught through the direct model reached 52.52 and grade XI IPA_5 which taught through the inquiry model reached 43.13.

The data shows that before being given treatment in both classes, grade XI IPA_2 achieved better than the class XI IPA_5 which would later treat through the inquiry learning model (see Fig. 1).

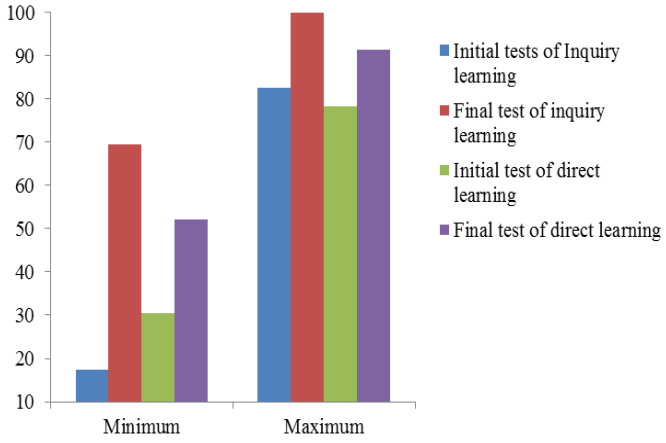

Fig 1. Data analysis of student physics learning outcomes on learning inquiry and direct learning

This because a material test has not been taught to students, so they answer questions by the experience of students in their daily lives. The difference between the average value of the initial test of inquiry learning and direct learning does not affect the results of the homogeneity test of the initial examination of inquiry learning and direct learning which states that the two classes are homogeneous.

The final test data shows that the average learning in the class taught through the inquiry model is higher than the lesson taught through the direct learning model. This show that input to the level with the inquiry model is better than the data of direct learning. The final test results on inquiry learning have an average value of 85.56, and the direct learning average value is 75.30. The difference in the average cost of inquiry learning and direct learning is due to the class using the inquiry learning model, where learning students can construct their knowledge through experiments that have while direct learning in education uses a direct learning model with demonstration methods.

Based on the comparison of the average final test scores of students using the inquiry learning model towards the final test scores of students using the direct learning model, it can conclude that the class that uses inquiry learning is significantly better than the class using direct learning. This means that inquiry learning can improve learning outcomes on static fluid topics.

TABLE III. Categorizing data on learning outcomes at the initial test for students on inquiry learning and direct learning

Value Interval	Category	Initial test			
		Inquiry learning		Direct learning	
		f	%	*f*	%
$X_i >$ 37,7	High	14	56	23	92
$18,8 \leq X_i \leq 37,7$	Medium	8	32	2	8
$X_i <$ 18,8	Low	3	12	0	0

f = Number of students

Based on table 3, it can explain that the learning outcomes of the initial test of inquiry learning students were mostly in the high category (56%), moderate (32%) and for the low grade (12%), while the students initial learning outcomes were students direct learning in the high category (92%), medium (8) and the rest in the low grade (0%). While based table 4 it is said in the final test the learning outcomes of inquiry learning students fall into the high category (56%), moderate (44%), and low grade (0%), while in the final test the learning outcomes of students direct learning as much as (20%) is in the high grade, (52%) in the moderate category, and as much (28%) in the low grade.

TABLE IV. Categorizing data on learning outcomes at the final test for students on inquiry learning and direct learning

Value Interval	Category	Final test			
		Inquiry learning		Direct learning	
		f	%	*F*	%
$X_i >$ 86,5	High	14	56	5	20
$69,1 \leq X_i \leq 86,5$	Medium	11	44	13	52
$X_i <$ 69,1	Low	0	0	7	28

f = Number of students

Table 4 provides information that the percentage of student learning outcomes using learning inquiry model is higher than the direct learning model. It was seen that the number of students in the high and low classes increased compared to the initial tests before the inquiry learning model was applied. whereas in the direct learning model there is a decrease in the number of students in education. This is because by using the learning learning model students are more active and responsive in solving problems. As expressed [17] that using learning models increases the activity of inquiry and implies the process of learning to enable students to answer research questions using data analysis and information exchange, which results in student-oriented learning. While the teacher only serves as an instructor during the learning process.

Furthermore, to see categorization of N-gain (increase) in student learning outcomes in inquiry and student learning, direct learning after learning as a whole can be seen in Table 5, can be see the percentage of N-gain (increase) of inquiry learning is more than the value with a high category compared with the value of N-gain (increase) learning direct learning students.

TABLE V. N-gain student learning outcomes in inquiry learning and direct learning

Value Interval	Category	N-gain			
		Inquiry learning		Direct learning	
		f	%	*f*	%
$0 \leq g < 0,3$	High	5	20	0	0
$0,3 \leq g \leq 0,7$	Medium	17	68	7	28
$0,7 < g \leq 1$	Low	21	12	18	72

f = Number of students

N-gain (increase) in student learning outcomes in inquiry learning values with a moderate category is less than N-gain (improvement) in learning outcomes of direct learning students. This is line in with [18] expression that the inquiry learning model is more effective than the conventional model. Inquiry-based learning used in the learning process can improve student learning outcomes because in the learning process structured activities are presented in the form of practicums and observations using inquiry-based learning [19-20]. Inquiry-based learning contains learning activities encourage students to analyze, solve problems based on facts found and designed to obtain students' conceptual understanding. So as a result in students to be interested and have an impact on improving the results of learning physics (see Table 5).

The results of the N-gain inquiry and direct learning calculation obtained the average N-gain value for inquiry learning at 0.75 and the direct learning N-gain value of 0.47. It can conclude that the increase in the average value of inquiry learning is higher than direct learning, this is because learning uses inquiry learning models where students are active in learning activities and can carry out scientific activities in discovering the concepts learned. Inquiry learning is one of them doing a practicum [21].

In practical exercises, students plan and work on their own and discuss the problems faced with group members, and the teacher as a facilitator to help students in working on the difficulties encountered [22]. This is in accordance with [23] that teachers play an important role in solving problems and teachers direct students at important times during the learning process. Furthermore, results can be seen in the analysis test of the effectiveness and efficiency of the learning model can see in Table 6.

TABLE VI. Experiment the effectiveness of the learning model

Learning model	Average value		Rasio	effectiveness
	Initial test	Finaly test		
Inquiry	43,13	85,56	42,43	98,37%
Direct	52,52	75,30	22,78	43,37%

The findings indicate that the learning outcomes of inquiry model learning, the achievement of the majority of students is at a good level. This means that inquiry-based learning can be used as one method to improve student learning outcomes and there are differences in student learning outcomes which take the inquiry learning model group with groups of students take conventional learning models, where students take the inquiry learning model get higher scores the group of students takes conventional learning models [24]. This is consistent with the research conducted which states that inquiry-based learning models are more effective than traditional learning models (lectures) with very high significance values [25-18]. This argument reinforced [26] arguing that inquiry-based learning has an effective teaching approach in education. This has an impact on increasing the acquisition of technological knowledge, developing problem-solving skills and the ability to make important decisions.

In addition, the data is strengthened from the results observations made by teachers and students seemed active and enthusiastic during the inquiry learning process. The implementation of learning at the first meeting is not maximal because students are not familiar with inquiry learning. But in the next learning meeting, activities can be carried out according to the plans that have made, the teacher can manage time well, and students carry out learning activities as a whole.

Based on the results of research that have been finished, that learning using inquiry learning models more effectively applied to static fluid learning activities in Senior Senior High School 1 Lawa because of the study conducted the learning outcomes of students learn through this model are higher than students learn through models direct learning.

IV. CONCLUSION

It has been successful in analyzing the differences between the average scores of the initial test results and the final tests of students taught through inquiry learning models and direct learning models on static fluid topics. While the inquiry learning model is more effectively used to improve the learning outcomes of Senior High School 1 Lawa students on topic static fluid matter rather than the direct learning model with an effectiveness of inquary learning 98,37% and direct learning 43,73 %. Learning by using inquiry inquiry is more effective.

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