The Influence of Experiment Methods on Science Process Skill and Cognitive Learning Outcomes of the X Grade Students of MIA SMAN 1 Soppeng Riaja 2015/2016

A. Sri Sofializa[1,a)], Muhammad Arsyad[2,b)], Muris[3,c)]

[1)]author , [2)]the first advisor, [3)]the second advisor

a) a.srisofializa@yahoo.co.id, b) m_arsyad288@unm.ac.id, c)muriscei@gmail.com

Abstract. This study aims to : (1) describe the level of science process skills of group was taught using the experimental method; (2) describe the level of science process skills of group that taught conventionally; (3) describe the level of physics learning outcomes of group taught using the experimental method; (4) described level of physics learning outcomes of group was taught by conventional method; (5) to analyze whether there are differences in science process skills between the groups taught by using experimental methods and the group that was taught in conventional; (6) to analyze whether there are differences in learning outcomes between the groups taught by using experimental methods and taught conventionally. This is a true experimental research with posttests only control group design. The population in this study was all students of class X MIA consisted of four classes. The study sample consisted of two classes of one experimental class taught by experimental methods and one class taught by conventional methods (demonstration method). Sampling was chosen randomly so that the class X MIA 1 as an experimental class and the class X MIA 2 as control class. The results showed that (1) science process skills of students who are taught by experimental method are on high category; (2) science process skills of students who are taught by applying the conventional method (demonstration) are on fair categories; (3) cognitive learning outcomes of students who are taught through experimental method are on high category; (4) cognitive achievement of student taught by applying the conventional method (demonstration) are on fair categories; (5) there is a difference between the science process skills of group who are taught using experimental methods and group that are taught conventionally; (6) there are differences in learning outcomes between the group taught by using experimental methods and group that are taught conventionally.

Keywords: Experimental Method, Science Process Skills, Cognitive Learning Outcomes

INTRODUCTION

Science as part of education which related to how to find out about nature systematically, so that science is not only emphasizes to the collection of knowledge (cognitive) such as facts, concepts, or principles but also emphasizes on process skills. Considered the importance of learning outcomes and science process skills in physics, then we need to be integrated them as a goal of physics learning. The teacher's role as a teacher is very important that these objectives can be achieved; the teacher should can to present the material well and the students involved in the learning process. Therefore, the selection method of learning by teachers must be in accordance with the topics to be discussed because every topic is different.

Based on the interview the researcher to physics teachers of SMAN I Soppeng Riaja there are some problems in the learning process. By nature, students tend to be passive, they just accept what is presented by the teacher without being able to express opinions, ask and answer questions.

In addition to the low quality of the output. One indicator of the criterion is the pure value of the National Examination (UN) obtained is still far from expectations. The mean value of Barru's National Examination on 2015 was 66.34 with integrity index was 49.04%, which for majoring in science, especially physics data from the National

Education Ministry shows that the mean value for the subjects of physics is still below of the minimum completeness criteria (KKM).

Based on the above problems, the teachers are required to change the method of learning in the classroom. According to Jerome Bruner cited by Dahar (1996) argues that "learners should to learn by participating actively to gain experience in finding principles".

One of the methods that are demanding activity and capable construction learners' knowledge and understanding that is the experimental method. Experimental method is a method of teaching which invites students to do experiments for evidence and checking that the theories that have been discussed are true (Suparno, 2007).

The use of the experimental method can make students more confident on theories, concepts and laws of physics based of their experiments outcomes, compared to just accept the teacher's explanation or reading a book. In addition to the application of the experimental method can also train science process skills of students and to train students to think scientific. Involvement of learners is expected to increase their understanding of the material presented, so that the learning outcomes of students will also be increased.

Several previous studies have also shown that the application of the experimental method has an influence on learning outcomes. Among the results of research Damayanti (2014), shows that there are effects of the experimental method to the learning outcomes of learners and Hidayanti physics (2012) shows the method of laboratory work gives a better effect on basic science process skills, and scientific attitudes of learners.

Based of thats all, so researchers interested to taking the title "The Influence of Experiment Methods on Science Process Skill and Cognitive Learning Outcomes of the X grade Students of MIA SMAN 1 Soppeng Riaja 2015/2016". Based thats all, the subject matter of this research are:

1. How big the level of science process skills of group was taught using the experimental method?
2. How big the level of science process skills of group that taught conventionally?
3. How big the level of physics learning outcomes of group taught using the experimental method?
4. How big the level of physics learning outcomes of group was taught by conventional method?
5. Are there differences in science process skills between the groups taught by using experimental methods and the group that was taught in conventional?
6. Are there differences in learning outcomes between the groups taught by using experimental methods and taught conventionally?

RESEARCH METHOD

This is a true experimental research with posttests only control group design that consists of one independent variable and two dependent variables as shown in the following figure.
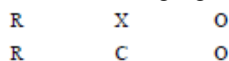
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Figure 1. Research Design

The population in this study was all students of class X MIA consisted of four classes. The study sample consisted of two classes of one experimental class taught by experimental methods and one class taught by conventional methods (demonstration method). Sampling was chosen randomly so that the class X MIA 1 as an experimental class and the class X MIA 2 as control class.

The procedure of research

The procedure of research carried out in three stages: the preparation stage, the implementation stage and reporting stage.

Preparation Stage

Activities in the preparation stage include:
1. Study of literature.
2. Survey the research location
3. Compile device of learning.
4. Check the availability of tool and ingredients in the school's laboratory.

5. Make research instruments that consisted of science process skills and physics learning outcomes test (especially cognitive aspect for fluid static material).
6. Validating device of learning and instruments by two experts
7. Analyze the experts' assessment and do revised according to both experts suggestion.
8. Do try out test of the instruments.
9. Analyzing result of the try out.
10. Compile final instrument according result of try out test.

Stage Implementation

Activities in the implementation stage include:
1. Give treatment on experimental class that is applying method experiment, while on control class applies conventional learning (demonstration method).
2. Give *posttest* on experimental and control class for measure science process skills and physics learning outcomes.

Reporting Stage

Activities reporting stage include:
1. Analyzing results of the research
2. Writing report result research

The instrument used to measure variables science process skills and cognitive learning outcomes in this study are a objective test sheet, with five answer choices symbolize a, b, c, d, and e. The tests are given after treatment.

Each correct answer on the instrument science process skills were given a score of 1, and for the wrong answer were given a score of 0. Instrument science process skills is confined to a few aspects of basic science process skills, including basic skills to observe, classify, predict, measure, communicate, and concluded.

Instruments of physics learning outcomes are confined to the cognitive aspect include: to comprehension, application, and analysis. Scoring of cognitive learning outcomes based on the level of items. Each correct answer to items of comprehension (C2) were given a score of 2, about the application (C3) were given a score of 3, and a matter of analysis (C4) were given a score of 4. But each wrong answer were given score of 0.

Descriptive Statistics Analysis.

The result of descriptive analysis described in the cluster data form that counted manually. The category scores determined by the equation on Table 1.

Table 1. Category score and interval equation (Widoyoko, 2015)

Equation Interval	Category
$X > \overline{X}_i + 1.8 \times sb_i$	Very High
$\overline{X}_i + 0.6 \times sb_i < X \leq \overline{X}_i + 1.8 \times sb_i$	High
$\overline{X}_i - 0.6 \times sb_i < X \leq \overline{X}_i + 0.6 \times sb_i$	Fair
$\overline{X}_i - 1.8 \times sb_i < X \leq \overline{X}_i - 0.6 \times sb_i$	Low
$X \leq \overline{X}_i - 1.8 \times sb_i$	Very Low

Based on the above equation, the category scores of science process skills and cognitive learning outcomes of students can be seen in Table 2.

Table 2. Science process skills and learning outcomes category score

Scores Interval		Category
SPS	**LO**	
21 – 25	61 – 75	Very high
16 – 20	46 – 60	High
11 – 15	31 – 45	Fair
6 – 10	16 – 30	Low
0 – 5	0 – 15	Very Low

And then analyzed the mean estimated, the equation used is (Sudjana, 2005):

$$\bar{X} - t_p \frac{S}{\sqrt{n}} \sqrt{\frac{N-n}{n-1}} < \mu < \bar{X} + t_p \frac{S}{\sqrt{n}} \sqrt{\frac{N-n}{n-1}}$$

Inferential Statistics Analysis

Testing of normality data

For the test used Chi-squared formula as follows:

$$X^2{}_{count} = \sum \frac{(f_0 - f_h)^2}{f_h}$$

Criteria testing: If $\chi^2{}_{count} < \chi^2{}_{table}$ with degrees of freedom (df) = (k – 1) at a significant level $\square\square= 0,05$, so the data is said to be normally distributed. (Sugiyono, 2015)

Testing homogeneity data

For the test used F-test formula as follows (Sugiyono: 2015):

$$F = \frac{the\ largest\ variance}{the\ smallest\ variance}$$

Testing Criteria: Homogeneous if $F_{count} < F_{table}$ at significant level $\alpha = 0,05$.

Hypothesis testing

The hypothesis in this study tested with the two side test which calculated manually, statistical hypothesis as follows (Sugiyono: 2015).

$$H_0: \mu_1 = \mu_2$$
$$H_1: \mu_1 \neq \mu_2$$

The hypothesis to be tested is calculated using two side t-test based on the number of students in the class samples are different ($n_1 \neq n_2$) but the variance for the two groups are homogeneous, then the formula used is *the t-test pooled variance* with degrees of freedom (df) = $n_1 + n_2 - 2$ (Sugiyono, 2015)

$$t_{count} = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1 + n_2 - 2}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Testing criteria: Ho accepted if $-t_{\left(1-\frac{1}{2}\alpha\right)(n_1+n_2-2)} < t < +t_{\left(1-\frac{1}{2}\alpha\right)(n_1+n_2-2)}$ and for another t value Ho rejected.

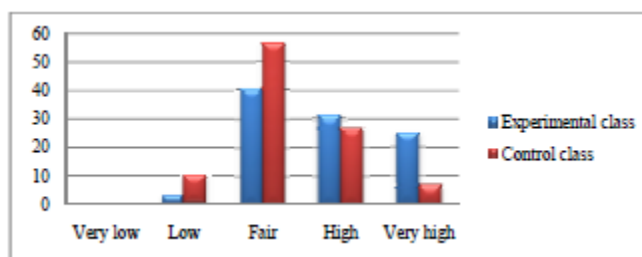## RESEARCH RESULT

Result of Descriptive Analysis

Description of students' science process skill

The result of descriptive analysis of the students' science process skills at the experimental and control class can be seen in Table 3.

Table 3. Recapitulation of students' science skills score at experimental and control class

Scores of Science Process Skills	Experiments class	Control class
Mean	17,453	14,500
Variance	15,631	12,650
Standard Deviation	3,953	3,556
Top Scores	25,00	22,00
Lowest Score	10,00	7,00
Range	15,00	15,00

The percentage of students' science process skills score at the experimental and control class can be seen in Figure 2.

Figure 2. Graph percentage of students' science process skill at experiment and control class
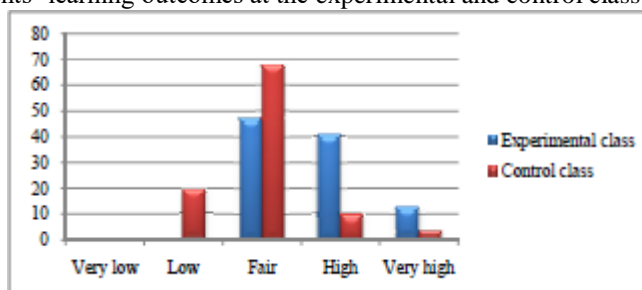
Description of students learning outcomes

The result descriptive analysis of the student's learning outcomes at the experimental and control class can be seen in Table 4.

Table 4. Recapitulation of students' learning outcomes score at experimental and control class

Score of Learning Outcomes	Experiments Class	Control Class
Mean	48.750	38.903
Variance	79.625	75.055
Standard Deviation	8.923	8.633
Top Score	70.00	61.00
Lowest Score	31.00	23.00
Range	39.00	38.00

The percentage of students' learning outcomes at the experimental and control class can be seen in Figure 3.

Figure 3. Graph percentage of students's learning outcomes at Experiment and Control Class.

Analysis of population estimates

Table 5. Analysis of population Average Estimated (Sudjana, 2005)

	Science Process Skills	Cognitive Learning Outcomes
Experimental class	$16,213 < \mu < 18,693$	$45,948 < \mu < 51,552$
Control class	$13,332 < \mu < 15,668$	$36,129 < \mu < 41,677$

The result of Inferential Analysis

Testing of normality data

Table 6. Recapitulation of data normality test

	Science Skills	Process	Cognitive Outcomes	Learning	Conclution
	χ^2_{count}	χ^2_{table}	χ^2_{count}	χ^2_{table}	Normally
Experimental class	9,206	11,07	7,703	11,07	
Control class	8,714	11,07	8,746	11,07	

Testing of homogeneity data

Table 7. Recapitulation of data homogeneity test

	Science Process Skills		Cognitive Learning Outcomes		Conclution
	Experimental class	Control class	Experimental class	Control class	
Varians	15,631	12,650	79,625	75,055	Homogeneous
F_{hitung}	1,236		1,061		
F_{tabel}	1,848		1,835		

Hypothesis Test

The first hypothesis

Based on the result of calculations using equation (4) obtained values t_{count} is bigger than t_{tabel} (3,062 > 2,000) the means that H_0 is rejected and H_1 accepted. So we can concluded that "There is a difference between the science process skills of group who are taught using experimental methods and group that are taught conventionally"

The second hypothesis

Based on the result of calculations using equation (4) obtained values t_{count} is bigger than t_{tabel} (4,442 > 1,999) the means that H_0 is rejected and H_1 accepted. So we can concluded that "There are differences in learning outcomes between the group taught by using experimental methods and group that are taught conventionally.

DISCUSSION

Science Process Skills and Cognitive Learning Outcomes Description

The results of research showed that the mean score of science process skills and cognitive learning outcomes in the experimental class is higher than the control class. Which the mean score of science process skills and cognitive learning outcomes obtained by students at the experimental class are on high category, while the mean score obtained by students at control class are on fair category.

The results of calculation also indicate the value of standard deviation in the control class is smaller than the experimental class. This means that science process skills scores obtained in control class more assemble than the experimental class. Nevertheless, the highest and lowest scores were obtained in the experimental class is higher than the score obtained in the control class.

So the learning process in the experimental class the students were led to build their own knowledge by directly experiencing and interacting with the real objects. The teacher only as a facilitator , his role to create favorable conditions and creation of meaningful learning so that the theory can survive long in the students's memory because the knowledge gained through scientific methods. The learning process that before centered on teachers changed to be student-centered learning.

This is consistent with the theory that also confirmed that students will get the best learning when they are actively in all activities in the classroom and have opportunity to find dan proved the theory by their selves (John Dewey, 2010). It is also in line with the opinion of Rustaman, according Rustaman (2005) practicum is the best means for developing science process skills.

Overall, students in the experimental class showed a higher interest in the learning process. This is indicated by many of students who submitted their hand to answer the questions given by the teacher. Although some students still give answers that are less precise, they are still trying to find the right answer. During the study, almost all students in the experimental class ever ride on the white board to answer the questions.

Hypothesis Test

Based on the analysis about the first and second hypothesis testing using the formula *t test polled variants* known H_0 is rejected and H_1 accepted, which means that there are significant differences. Which the experimental method give a more positive effect than conventional learning.

Basically, using the experimental method will be able to give a more positive effect than the method of demonstration. experiment activity can enhance the actively of learners as well as train and hone their science process skills, so learners' comprehension and retention about a concept of physics is becoming stronger. If students have stronger comprehension and retention about a concept of physics then automatically also will give a positive impact to learning outcomes.

CONCLUSION

The results showed that
1. Science process skills of students who are taught by experimental method are on high category;
2. Science process skills of students who are t aught by applying the conventional method (demonstrasi) are on fair categories;
3. Cognitive learning outcomes of students who are taught through experimental method are on high category;
4. Cognitive achievement of student taught by applying the conventional method (demonstration) are on fair categories;
5. There is a difference between the science process skills of group who are taught using experimental methods and group that are taught conventionally;
6. There are differences in learning outcomes between the group taught by using experimental methods and group that are taught conventionally.

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