

# The Effectiveness of Physics Demonstration Kit

*by Yetri Dkk.*

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## The Effectiveness of Physics Demonstration Kit: The Effect on The Science Process Skills Through Students' Critical Thinking

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## The Effectiveness of Physics Demonstration Kit: The Effect on The Science Process Skills Through Students' Critical Thinking

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**Abstract.** This study aims to know the effectiveness the use of physics aids toward science process skill in terms of students' critical thinking abilities of electromagnetic induction material. This research is a Quasi-experimental research design with Non-equivalent Control Group design. The population in this study were students of class XII of SMA N 1 Tegineneng Lampung Selatan with the total of 42 students. Hypothesis testing uses two-way variance analysis, with a significant level of 5%. Prior to the prerequisite test which includes normality test by using liliefors test and homogeneity test. From the hypothesis test analysis shows that  $\alpha$  is 0.204 > 0.05, then effects known by the effect size test that is to obtain the value of  $d = 0.21$  then this result is interpreted with the effect size table obtained that the use of teaching aids affect learning outcomes as much as 58 %. In conclusion (1) the use of physics teaching aids provides good science process skills (2) there are differences in science process skills between high, medium, low critical thinking skills. (3) there is no interaction between the use of physics teaching aids and the ability to think critically about science process skills.

### 1. Introduction

The development of science and technological advances make education a very important aspect for humans because education plays a very important role in the process of improving the quality of human resources. [1-3]. One effort that can be done to create human quality is to improve the quality and quality of education. [4-5] Schools have a large role in shaping perspectives and mindsets to be more positive and advanced, building good character through moral education and manners through various disciplines. One of the disciplines is physics. Physics has an important role in various disciplines because it is a product and process to advance human thinking, by studying physics can form a process of learning and scientific work [4,6,7]

Science process skills are the abilities and competencies displayed when solving scientific problems so as to produce concepts, theories, principles, laws, and facts. [8][9][10]. The implementation of science process skills will form students' thinking skills such as critical thinking skills [10] and the other aim of science education is to educate individuals who can think critically [11]. Critical thinking is a reflective and reasoned way of thinking that focuses on decision making to solve problems. Basically the ability to think critically is developed into indicators that consist of five groups, namely: 1) giving a simple explanation (elementary clarification), 2) building basic skills (basic support), 3) concluding (inference), and 4) making further clarification, and 5) applying strategies and tactics [11].

Based on the results of the researcher's interview with physics subject teacher at SMA N 1 Tegineneng, the physics teacher more emphasized teacher-centered learning. The teacher tends to emphasize mathematical equality in solving physics problems and not train students in science process skills, so understanding physics concepts are still low. This is reinforced by students' physics value data.

The low learning outcomes of students because the teacher has not fully involved students to think independently in solving problems and understanding the material during learning. Thus, the teacher



has never or just seen the science process skills of their students due to the inappropriate learning media used during the teaching and learning process that can develop science process skills. Understanding and Application of concepts that are still low indicates that the science process skills of students are also low. This is because the application of concepts is one indicator of the ability to the scientific process.

The low understanding of students' concepts is due to a lack of innovation in teaching students, and the use of appropriate learning media. It does not mean that the teacher is not creative, but the teacher must be able to make students more active, creative, and comfortable in receiving lessons [12]. Through experiments in the laboratory, in addition to improving science process skills, students are also able to achieve three domains together, namely cognitive, affective and psychomotor levels [13]. To be able to do practical work in learning physics at school, of course, learning media is needed for teaching aids and learning media in the form of physics teaching aids can be used to develop scientific work in the form of science process skills [13-14]. Media is a communication tool to make the learning process more effective [15]. The use of teaching aids is expected to attract students to be motivated and create students' creativity. So the teaching aids are very effective and efficient to use in the process of learning physics.

One concept of physics that is abstract and not easily seen directly, the concept of electromagnetic induction. To describe magnetic induction is necessary to use learning media in the form of props to explain the process of magnetic induction. Learning media in the form of electromagnetic induction physics teaching aids can be used to develop science process skills [2] in this study researcher used electromagnetic induction learning media with the learning process scientific approach Based on the description, the researcher will conduct a study with the title "effectiveness of the use of physics teaching aids on science process skills in terms of science process skills".

## 2. Research Method

The type of research used is the Quasi-Experiment Design method with non-equivalent control group design [6]. This research was conducted at Senior-Junior High School 1 Tegineneng 2018-2019 school year in two classes, class XII MIA 1 and XII MIA 2.

The steps taken in this study are (1) pre-survey, (2) make research instruments, (3) conducting an instrument trial, (4) giving a pre-test to the control class and experimental class students, (5) provide treatment by using Physics teaching aids for experimental class students, while for the control class only using the conventional media, (6) giving a post-test to the experimental class and control class students, (7) analyzing the data.

The instruments used in this study were tests of critical thinking ability, observed in the form of science process skills and documentation. Tests given for pre-test and post-test are in the form of an essay which is adjusted to the cognitive outcome learning indicators of the questions made as many as 10 items that have been tested. Observed in the form of science process skills of students appears during the learning process, while observer as an observer to see the implementation of the physics teaching aids type of scientific by researchers. The documentation method is used to retrieve written data, such as the names of students, school profiles, lists of student learning outcomes, and other things needed in the study.

Analysis of the validity test, the level of difficulty, the power of difference, the reliability test and the effect of deception on items about learning outcomes.

**Table 1** Results of Validity Analysis, Difficulty Level and Difference Power

Instrument Test	Number of question categories		
Validity	10 Valid	10 Invalid	
Difficulty	3 Easy	14 Medium	3 Difficult
Difference Power	6 Bad	3 Moderate	7 Good

In this study, the questions used as a test of physics learning outcomes are questions that meet the criteria. Based on table 1 above, it is known that out of 20 essay questions there are 10 questions that are declared valid and 10 more are declared invalid. The questions used in that have a medium difficulty level of 14 questions, easy 3 questions, difficult 3 questions and with different power in the medium category as many as 3 questions, good 7 questions, bad as many as 6 questions, as well as deceptive effects in the category all right.

The difference between the pretest and posttest value is n-gain. To know the cognitive ability of student with formulas normalized gain [17] :

$$\text{Normalized gain (g)} = \frac{\text{posttestscore} - \text{pretestscore}}{\text{idealscore} - \text{pretestscore}}$$

**Table 2** Modified normlized gain interpretation

Normalized gain value	Interpretation
N-gain < 0,30	Low
0,30 ≤ N-gain < 0,70	Medium
N-gain ≥ 0,70	High

### 3. Result and Discussion

Based on the results of the study showed that the average value of pretest and posttest in the experimental class was higher in the posttest value after being given treatment than the pretest value compared to the control class.

**Table 3** Mean Pretest-Posttest Results Data, N-Gain Experiment and Control Classes

Class	Average Value		
	Pretest	Posttest	Ngain
Experimental	59	79	0,49
Control	66	76	0,30

In the experimental class getting a pretest score of 59 has an increase of 79. In contrast to the results of the average pretest and posttest of the control class of 66 experienced an increase in the posttest of 76. The higher the posttest results in the experimental class is 79. This is because in the experimental class, besides using the use of physics teaching aids media.

Based on the results of the N-Gain calculation calculated from the pretest and posttest stated the same thing is that there is a significant difference between the N-Gain value in the experimental and control classes. The average value of the N-Gain experimental class obtained a value of 0.49 with a medium criterion and the average value of the control class N-Gain was 0.30 with low criteria. It can be seen that the average N-Gain experimental class is higher than the control class. This can be an indicator that the learning outcomes of the experimental class using physics teaching aids media can be increased. The control class using direct learning and experimental class using learning media in the form of teaching aids

Prerequisite testing is carried out with the aim whether the data obtained is normally and homogeneously distributed. Then test how much influence the physics demonstration kit on students' science process skills and critical thinking, in this study prior to the prerequisite test data analysis. Prerequisite test data analysis using normality and homogeneity. The results of the science process skills normality test of the experimental class and the control class  $\alpha = 0,05$  and sig 0,2 to result in  $L_{\text{Calculate}} < L_{\text{table}}$  distributed normally.

Based on the results of the normality of critical thinking in the control and experimental classes, the results in Critical Thinking high  $\alpha = 0,05$  and sig 0,104 and Critical Thinking medium  $\alpha = 0,05$  and sig 0,113 and then Critical Thinking low  $\alpha = 0,05$  and sig 0,20 to result in  $L_{\text{Calculate}} < L_{\text{table}}$  distributed normally.

The results of the post-test homogeneity of the control class and the experimental class used homogeneity of variance data of homogeneity science process skills result  $0,515 > 0,05 = \text{Sig} > \alpha$  (Homogeneous) and homogeneity of variance data of homogeneity critical thinking result  $0,70 > 0,05 = \text{Sig} > \alpha$  (Homogeneous).

This hypothesis test uses a two-way variance analysis test on the SPSS 17 statistical application.

**Table 4** Description of Science Process Skills Data

Class	ΣData	Max	Min	Average	SD
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Control	26	88	63	76	8
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table 4 showed the value of science process skills shows that the average value of science process skills experimental class is better than the control class, with the distribution of values that are not much different. It is indicated by the standard deviation, when standard data deviation is near zero, the data distribution more balance with the average data value. It means that the distribution of data obtained is getting better.

**Table 5** Description of Science Process Skills Data reviewed from the Critical Thinking

Critical Thinking	Treatment		Conventional		Amount
	Frequency	Percentage	Frequency	Percentage	
High	11	42,3%	6	23,%	17
Medium	12	46,1%	12	46,1%	24
Low	3	11,5%	8	30,7%	11
Sum	26	100%	26	100%	52

In table 5 it can be seen that the description of the data of science process skills in terms of critical thinking skills, the average value of the experimental class science process skills are better than the control class. Whereas the high-level category of critical thinking ability is better experimental class than the control class, the low-level category of critical thinking ability, almost the same value.

In this study intends to determine the effectiveness of the use of physics teaching aids in science process skills in terms of critical thinking skills. The effect of this study was measured using the effect size. Effect size test results post-test critical thinking ability that is getting the value of  $r_{ya} = 0.21$  then this result is interpreted by using the effect size table obtained that the use of this teaching aid affects the science process skills of students as much as 58%. So it can be concluded that the use of physics teaching aids can improve science process skills in the medium criteria.

Hypothesis testing is done by using Variant Analysis to see whether or not there is an interaction between the variables studied, namely the science process skills and students' critical thinking skills. Two-way ANOVA technique using SPSS 17 with the test criteria used is  $F_{count} > F_{table}$  at a significant level  $\alpha = 0.05$ , then the proposed hypothesis is accepted.

After the suitability test of the data and the data was declared homogeneous, the two-way ANOVA test was carried out with the help of SPSS 17.

**Table 6** Two-Way Anava Test Result

Sources	Sum of Square	df	Average Square	F	Sig.
Corrected Model	1381.064 <sup>a</sup>	5	276.213	7.154	.000
Intercept	253049.107	1	253049.107	6554.507	.000
Treatment	257.776	1	257.776	6.677	.013
Critical Thinking	629.730	2	314.865	8.156	.001
Treatment * Critical Thinking	77.499	2	38.749	1.004	.374
Error	1775.917	46	38.607		
Total	327531.000	52			
Corrected Total	3156.981	51			

The results of the *N-Gain* test showed the results of the difference between *pretest* and *posttest* scores in both the experimental and control classes, It can be seen in table 3. This can also be an indicator that students' critical thinking skills in the experimental class using physics teaching aids are higher than the control class that uses conventional learning media. The use of physics teaching aids trains students to

be independent, creative, and active during the learning process.[9] So that educators act as a facilitator and provide opportunities for students directly involved in the learning process. So that the teaching aids used can develop the skills of the science process for students. this research is in line with previous research[16,18,19]that learning media is in the form of effective teaching aids to develop science process skills in terms of critical thinking skills.

Based on the description above, it can be concluded that critical thinking skills above average will be better to use physics teaching aids that have critical thinking skills above than the average use with conventional learning media.

#### 20 Conclusion

Based on the results of research and discussion, can be concluded that 20 item questions of two-tier multiple choices instrument to measure students' higher-order thinking skills in the static fluid are declared valid based on Aiken Validity. The two-tier multiple choices instrument represents indicators to measure higher-order thinking skills.

#### 4. Conclusion

The use of physics teaching aids gives good results on electromagnetic induction material. Science process skills students who have high critical thinking skills are better than science process skills students who have low critical thinking. Judging from the interaction between the use of physics demonstration kit and the ability to think critically of students towards science process skills, there was no interaction between the use of physics teaching aids and students' critical thinking towards scientific process skills. The use of physics demonstration kit is more effective than learning with conventional learning media.

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