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Meta Analysis of the Effectiveness of Using Student Worksheet on the Learning Outcomes of High School Physics Students

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ABSTRACT

The urgency of this research is was to determine the effectiveness of using Student Worksheet on learning outcomes of high school physics students. The method used in this research is meta-analysis. The data were analyzed secondary data obtained from several previous research results. The sample of this study used 22 articles consisting of Sinta 3, national and international accredited journals. The instrument used was coding category. The data analysis technique in this study was to use the calculation of the effect size value in each article. Based on the research data obtained that the effectiveness of using student worksheet on learning outcomes can be concluded that the use of student worksheet on learning outcomes of high school physics students has an average effect size value of 1.67 in the Very High category, the use of student worksheet on learning outcomes of physics high school students based on learning material, namely with a very high category in the material Fluid has an effect size value of 1.30 and Static Fluid has an effect size value of 9.25, and the use of student worksheet on the learning outcomes of high school physics students based on class level with a very high category at class X has an effect size value of 1.23.

INTRODUCTION

Education a process of planned activities in transferring knowledge from someone with knowledge to another person. Education brings people from initially not knowing to becoming knowledgeable. Apart from knowledge, an educated person can change his attitude and character for the better. Education itself can be obtained through formal education. Formal education is education obtained in an educational unit. Education can accommodate the formation of capable human resources. The government is very serious about forming human resources by perfecting the curriculum. The curriculum continues to be refined. Currently the education unit uses the 2013 curriculum. Learning resources that can be used in learning are in the form of printed teaching materials. By using teaching materials, teachers can encourage and facilitate students in learning (Asrizal & Festiyed, 2020). One of the printed teaching materials that can be used in learning is the Student Worksheet.

The 2013 curriculum currently being implemented in Indonesia is an effort to implement learning demands that are appropriate for the 21st century. The 2013 curriculum requires learning to be responsive to developments in science, technology, arts and culture to build students' curiosity and abilities (Kemendikbud, 2014). The 2013 curriculum or often called K-13 is the curriculum currently used in Indonesia. The K-13 curriculum refers to 4 attitude skills, namely knowledge, skills, spiritual attitudes, and social attitudes. The most prominent characteristic of K-13 is the student center or student-centered learning. K-13 learning is in line with the skills needs of the 21st century. 21st century learning is student-centered through collaboration (Asrizal, A., et al, 2018). All activities are centered on student activities. Students are not only given material, but students are involved in learning. Teachers only act as facilitators and are regulated by national standards.

One of the national education standards in K-13 is process standards. Process standards state that teachers play an important role in the classroom. The teacher is a facilitator in preparing learning with these skills. Teachers are expected to be able to prepare learning in the form of mental, physical and social (Festiyed, 2013). In this case, teachers should be able to encourage students' acquisition of new knowledge, improve students' skills, gain students' learning experience and build attitudes that enable students to learn (Asrizal, et al: 2019) Education is expected to provide human knowledge and skills so that they can develop their own potential, empowering the potential of nature and the environment for the benefit of their lives. The success of an education is closely related to the problems faced in order to achieve success in the learning process. This educational development is carried out to answer and face the challenges of future developments in Science and Technology (IPTEK). One of the sciences that supports Science and Technology is physics.

Physics is a field of science that underlies the development of advanced technology and the concept of living in harmony with nature. Physics not only makes a real contribution to the development of technology, but physics education also forms people who have good reasoning and thinking power, are creative, intelligent in solving problems and educate students in learning. The government has made various efforts to improve the quality of national education, including improving the curriculum. To create educational graduates who have these advantages, the learning process in each primary and secondary education unit must be interactive, inspiring, fun, challenging, and motivate students to actively participate, be creative, and be independent in accordance with the students' talents, interests, and physical development.

Apart from government efforts, teachers also carry out various efforts, including planning learning activities systematically and providing teaching materials to support the learning process so that students can study the material independently and change their perspective from teacher-centered to student-centered learning. Even though various efforts have been made in learning physics, it is still found that learning is less effective by students. Effectiveness is the level of success in achieving goals or targets (Simamora, 2008:31). Achieving these goals takes the form of increasing knowledge and skills as well as developing attitudes through the learning process. Increasing the effectiveness of the learning process can be done by using teaching materials. One of the teaching materials used to support learning process is the Student Worksheet.

The existing Student Worksheet in printed form is still not effective and is less practical to use. So according to Herawati et al (2016), to optimize it both in terms of appearance and quality of learning, a transformation based on the convergence of information and telecommunications technology (ICT) is needed. According to Dewi (2010), learning carried out using interactive worksheets can create a learning atmosphere that is fun and not boring, students will not feel pressured, will not be afraid to ask questions and the learning atmosphere will not make students tense. Then Prastowo (2015) stated that Student Worksheet

has 4 functions as follows: 1) As teaching material that minimizes the role of educators, but further activates students. 2) As teaching material that makes it easier to understand the material provided. 3) As teaching material that is concise and rich in tasks for practice. 4) Facilitate the implementation of teaching to students.

The problem found in the world of education today is that teaching materials in the learning process have been implemented in several schools, but are not yet comprehensive so that there is a lack of information obtained by students, students only receive explanations from the teacher without responding to the material explained by the teacher. Students who are less active in asking questions result in material that they don't understand continuing to pile up and as a result students think physics is difficult and boring.

Meta- analysis research is the right solution for researchers to choose. The reason researchers chose this meta-analysis research was for several reasons, namely: 1) looking at the consistency of the research results, 2) looking at research with a wider scope, 3) needing to study effect size, 4) looking at broader research conclusions. Based on the problems that have been explained, researchers are interested in conducting research using the meta-analysis method. Therefore, the research purpose is "Meta Analysis of the Effectiveness of Using Student Worksheet on the Learning Outcomes of High School Physics Students"

METHODS

The Method of research in this research is meta-analysis by examining 22 articles in accredited journals Sinta 3, national and international journals. The articles analyzed are from 2013-2023. Meta analysis is the quantitative analysis of quite a lot of data, as well as applying statistical methods by practicing them in organizing a number of information originating from large samples whose function is to complement other purposes. The data in this study uses secondary data selected from several previous research results.

The instrument used in this research was carried out using a coding *category sheet* . Pengko dean (*coding*) in meta-analysis is an important requirement for collection and data analysis made easy . The aim is that the variables used for coding can provide the required information .

The data collection technique is a documentation technique for the components in several articles to be studied. The articles obtained are related to the use of Student Worksheet for learning outcomes as well as selecting articles that have been obtained through Google Scholar. In meta-analysis, data tabulation procedures are required in research. As for The tabulation procedure can be seen as follows: 1) identify the research variables and enter them into the appropriate variable column, 2) identify the average value and standard deviation of the control and experimental classes, 3) if the standard deviation is unknown, then the next step is analyze the t value in each article and 4) carry out data analysis to determine the *effect size* value using the Glass equation (Glass, 1981) . The equation is:

$$ES = \frac{\bar{x}_{post} - \bar{x}_{pre}}{SD_{pre}} \quad (1)$$

Information :

ES : *Effect Size*

$\bar{x}_{pre}$: Pretest average score

$\bar{x}_{post}$: Posttest average score

SD_{pre} : Pretest standard deviation

After *the effect size* is calculated, it is then categorized at the following levels:

Table 1. *Effect Size* (ES) Criteria

No	ICE	Category
1	ES ≤0.15	Negligible
2	0.15<ES ≤0.40	Low
3	0.40<ES ≤0.75	Currently
4	0.75<ES ≤1.10	Tall
5	1.10<ES ≤1.45	Very high

Another equation for finding *the effect size* is as follows:

a. Mean and standard deviation of two groups post t test only

$$ES = \frac{\bar{x}_E - \bar{x}_C}{SD_C} \quad \text{.....(2)}$$

Information :

ICE : *Effect Size*
$\bar{x}_E$: The average post test score of the experimental group
$\bar{x}_C$: The average post test score of the control group
SD_C : Control standard deviation

b. Mean and standard deviation of two group pre-post test

$$ES = \frac{\left(\bar{x}_{post} - \bar{x}_{pre}\right)_E - \left(\bar{x}_{post} - \bar{x}_{pre}\right)_C}{\frac{SD_{preC} + SD_{preE} + SD_{postC}}{3}} \quad \text{.....(3)}$$

Information :

ICE : *Effect Size*
$\bar{x}_{post}$: Posttest average score
$\bar{x}_{pre}$: Pretest average score
$\left(\bar{x}_{pre}\right)_E$: The average pretest score of the experimental group
$\left(\bar{x}_{post}\right)_E$: The average posttest score of the experimental group
$\left(\bar{x}_{pre}\right)_C$: Control group pretest mean score
$\left(\bar{x}_{post}\right)_C$: The average posttest score of the control group
SD_{preC} : Control group pretest standard deviation value
SD_{preE} : Experimental group pretest standard deviation value
SD_{postC} : Control group posttest standard deviation value

c. If the standard deviation is not known then it can be done using the t test

$$ES = t\sqrt{\frac{1}{n_E} + \frac{1}{n_C}} \quad \text{.....(4)}$$

Information :

ICE : *Effect Size*
t : T test results
n_E : Number of experimental group samples
n_C : Number of control group samples

RESULTS AND DISCUSSION

Results

This research is meta- analysis research. The analysis used 22 articles from 2013 to 2023 consisting of Sinta 3, national and international accredited journals related to the Effectiveness of Using Student Worksheet on the Learning Outcomes of High School Physics Students. Articles in the last 10 years that have been selected for this meta- analysis are coded J1 to J22. The results of the meta-analysis of 11 journals can be seen in Table 2.

Table 2. *Effect Size Value* of The Effectiveness of Using Worksheet on the Learning Outcomes of High School Physics Students

No	Teaching materials	Journal Code	*Effect Size*	Average *Effect Size*	Category
1	Student Worksheet	J1	0.68		
2	Student Worksheet	J2	4.14		
3	Student Worksheet	J3	4.17		
4	Student Worksheet	J4	0.74		
5	Student Worksheet	J5	3.96		
6	Student Worksheet	J6	2.20		
7	Student Worksheet	J7	2.58		
8	Learner Worksheet	J8	9.25	1.67	Very high
9	Student Worksheet	J9	0.63		
10	Learner Worksheet	J10	0.70		
11	Learner Worksheet	J11	0.03		
12	Student Worksheet	J12	1.54		
13	Student Worksheet	J13	1.19		
14	Student Worksheet	J14	1.57		
15	Student Worksheet	J15	0.50		

16	Student Worksheet	J16	1.09
17	Student Worksheet	J17	0.91
18	Student Worksheet	J18	0.73
19	Student Worksheet	J19	0.42
20	Student Worksheet	J20	0.55
21	Student Worksheet	J21	0.59
22	Student Worksheet	J22	1.30

Based on Table 2, it can be seen that the teaching materials used are Student Worksheet on learning outcomes. J1-J22 are the journal codes analyzed. From the results of calculating the effect size value, the average effect size value is 1.67 in the Very High category. The next analysis is the effectiveness of using Student Worksheet on the learning outcomes of high school physics students based on learning materials. The results of the analysis that has been carried out can be seen in table 3.

Table 3. *Effect Size Value* of The Effectiveness of Using Student Worksheet on The Learning Outcomes of High School Physics Students Based on Learning Materials.

No	Journal Code	Material	*Effect Size*	Category
1	J8	Static Fluid	9.25	Very high
2	J10	Rotation of Rigid Bodies and Fluids	0.70	Currently
3	J20	Concept of Elasticity and Vibration	0.55	Currently
4	J22	Fluid	1.30	Very high

Based on the data in Table 3, it can be explained that the results of the meta-analysis of the use of Student Worksheet on the learning outcomes of high school Physics students, there are four journals in terms of Learning Materials, namely the Static Fluid *Effect Size material* of 9.25 in the very high category, the Rotation of Rigid Body and Static Fluid *Effect Size material. The size* is 0.7 in the medium category, the Concept of Elasticity and Static Vibration *Effect Size* is 0.55 in the medium category, and the Fluid *Effect Size* is 1.30 in the very high category. So, it can be concluded that *the Effect Size value* of using Student Worksheet on the learning outcomes of high school physics students based on the learning materials used gives different values. The next analysis is an analysis of the effectiveness of using Student Worksheet on the learning outcomes of high school physics students based on class level. The results of this analysis can be seen in Table 4.

Table 4. *Effect Size Value* of The Effectiveness of Using Student Worksheet on the Learning Outcomes of High School Physics Students Based on Class Level

No	Class	Journal Code	*Effect Size*	Average *Effect Size*	Category
1	X	J1	0.68	1.23	Very high
2		J5	3.96		
3		J15	0.50		
4		J16	1.09		
5		J18	0.73		
6		J19	0.42		
7	XI	J10	0.70	0.95	Tall
8		J11	0.03		
9		J12	1.54		
10		J13	1.19		
11		J17	0.91		
12		J22	1.30		

Based on the data in Table 4, it can be explained that the results of the meta-analysis of the use of Student Worksheet on the learning outcomes of high school physics students are twelve journals in terms of class level, namely in Class X and Class XI. Where Class X has an average *Effect Size value* of 1.23 in the Very High category and Class XI has an average *Effect Size value* of 0.95 in the High category.

Discussion

The research is research that aims to see the results of research related to the effectiveness of using Student Worksheet on the learning outcomes of high school physics students. This research calculates the effect size value of the relationship between variables and other variables. namely the effectiveness of using Student Worksheet on the learning outcomes of high school physics students.The results of this research were carried out in three categories, namely *the effect size* of the use of Student Worksheet on the learning outcomes of high school physics students, *the effect size* of the use of Student Worksheet on the learning outcomes of high school physics students based on learning material, and *the effect size* of the use of Student Worksheet on the learning outcomes of high school physics students based on level. class. The results of this research show that the use of Student Worksheet on the learning outcomes of high school physics students has increased.

The results of the first research based on the use of Student Worksheet on the learning outcomes of high school physics students had a very high effect. The use o Student Worksheet in physics learning has a very good effect on the learning outcomes of high school students. This shows that the Student Worksheet used is effective on the learning outcomes of high school physics students. This is supported by Yuliska (2020) who states that effectiveness is related to the final increase in student learning and the progress that students make using lesson Student Worksheet or other educational products. This is what causes students' learning outcomes to be high because they have used the Physics Student Worksheet.

The results of the second research were based on the use of Student Worksheet on the learning outcomes of high school physics students, reviewed in the learning materials. According to the results of the *Effect Size* calculation, there are four learning materials. Of the four learning materials, there are two materials that have a very high category, namely Fluids

and Static Fluids. This shows that the effective use of physics Student Worksheet in learning is on student learning outcomes.

The results of the third research are based on the use of Student Worksheet on the learning outcomes of high school physics students in terms of class level, namely class X and class XI. In the results of the meta-analysis, it was found that the use of Student Worksheet based on class level showed that class X had a very high category and class XI had a high category. This means that the use of Student Worksheet on the learning outcomes of high school physics students is effective.

CONCLUSION

Based on the meta-analysis carried out, it can be stated that there are three results from this research, namely, the use of Student Worksheet on the learning outcomes of high school physics students has an average *effect size value* of 1.67 in the Very High category, the use of Student Worksheet on the learning outcomes of high school physics students is based on learning material, namely in the very high category, Fluid material has an *effect size value of* 1.30 and Static Fluids has an *effect size value of* 9.25, and the use of Student Worksheet on the learning outcomes of high school physics students based on class level with a very high category in class X has an *effect size value of* 1.23. The third effect of the application of Student Worksheet in science and physics learning based on the applied learning model obtained an average effect size value of 1.23 with a high category. Based on the results of the effect size analysis, it can be concluded that the use of Student Worksheet can improve student learning outcomes in science and physics learning.

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