

## META-ANALYSIS OF THE EFFECT OF USE WORKSHEETS ON STUDENTS CRITICAL AND CREATIVE THINKING SKILLS IN LEARNING NATURAL SCIENCE IN JUNIOR HIGH SCHOOL AND PHYSICS IN SENIOR HIGH SCHOOL

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### ABSTRACT

*This research is a meta-analysis of the influence of student worksheets on students' critical and creative thinking skills. Education currently uses the 2013 curriculum. The curriculum demands to learn that provides opportunities for students to develop all their potential. This meta-analysis study aims to determine the effect size value of the effect of using worksheets on students' critical and creative thinking skills based on education level, material unit, and learning model. The sample of this study used 20 national and international articles. The articles used in this study have been analyzed and meet the categories for effect size calculations and are grouped based on three indicators. There are three group indicators analyzed, namely based on education level, based on material units, and based on learning models. The results of this meta-analysis study are 1) Based on junior high and high school education levels, the effect of using student worksheets is equally effective against improving critical and creative thinking skills, but when compared to the effect size results, the senior high school level has a higher value, 2) Based on the material unit, fluid material units are more effectively used to improve critical and creative thinking skills, and 3) Based on the learning model, the cooperative learning model is effectively used to improve critical thinking skills and problem-solving is effective to improve students' creative thinking skills.*

**Keywords:** *Meta-Analysis; Student Worksheets; Critical Thinking; Creative Thinking.*



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### I. INTRODUCTION

This development in the field of education has caused the government to seek adjustments to the education system. In Permendikbud number 21 of 2016 concerning Content Standards for Primary and Secondary Education, it contains efforts to realize national education goals [1]. The government's efforts to achieve educational goals by increasing human resources to be superior and qualified for the field of education through curriculum development. Education currently uses the 2013 revised 2017 curriculum. The 2013 curriculum has an impact on changes in the 21st century learning process. 21st century learning is learning that requires competencies and skills including critical and creative thinking skills [2]. In this case, efforts are also made to meet the needs of facilities and infrastructure to achieve learning objectives, including in learning science and physics.

Science learning is one of the models for implementing the 2013 curriculum. Science is learning whose series of processes are known as scientific processes [3]. Science learning is student-centered learning to be active, examine and obtain concepts and principles that are obtained independently, usefully, and actively. For this reason, the learning atmosphere is expected to increase students' curiosity in finding information about any source.

Physics is one of the lessons within the scope of science. Physics is a subject that is closely related to the environment or everyday life. Physics can be interpreted as a lesson that is closely related to natural phenomena so that it gets the rules or laws in physics. Learning physics includes many phenomena or events that often occur

in life. In physics materials including mechanics, magnetism, electricity, heat, and waves, there are unique things that often occur to our lives but cannot be directly noticed by students. To be able to build critical and creative thinking skills, learning resources such as printed teaching materials is needed that support the learning process. Of the many types of printed teaching materials, the one used are the use of Student Worksheet.

Based on the results of the analysis of 20 articles, it was found that the real conditions were not commensurate with what was expected in achieving the learning objectives. The first real condition is that students' critical and creative thinking skills are still low, students find it difficult to understand the material and apply it in life so that it has not been implemented optimally [4], other factors are also such as the use of media that is not by student needs [5].

The second real condition is that learning still tends to be teacher-centered, teachers are still very dominant and students tend to be monotonous [6]. and make students less flexible to build their thinking skills [7]. The third real condition in learning has not seen students apply critical and creative thinking skills, this happens because students have difficulty solving problems with high-level categories. The learning process has not made students think critically and creatively. It takes worksheets to direct students to be able to find and analyze their concepts [8].

Because there is a difference between real conditions and conditions that should be, a solution is needed for this problem. The solution that can be used is the use of worksheets for students' critical and creative thinking skills. Many studies have been done on the effect of worksheets. The results of the study stated that there was a good effect of using worksheets on students' critical and creative thinking skills. Therefore, the researcher tries to summarize all the research to find out the effect size of how strong the research has been done.

Based on the problems that has been described, the researchers conducted a study using the meta-analysis method. With these statements and ideas, the title of this research is "Meta-Analysis Of The Effect Of Use Worksheets On Students Critical And Creative Thinking Skills In Learning IPA In Junior High School And Physics In Senior High School"

## II. METHOD

This research is using the meta-analysis method. The meta-analysis include research that is quantitative because it calculates it with numbers and statistics from many data sources [9]. The grouping of research data is done by browsing articles in journals and proceedings. The procedures for the meta-analysis are: (1) Determining the criteria and understanding the title to be summarized; (2) Strategies in browsing articles and browsing the literature; (3) clear categories in assessing the quality of articles of analysis; (4) Grouping of research indicators; (5) Planning the use of statistics to be used; (6) Calculating the effect sizes to value; (7) Identify the presence or absence of heterogeneity; (8) Interpreting research results and making reports.

The method of taking the research sample is purposive sampling, which means that the sample is taken based on the specified criteria. The samples of this study were 20 articles that met the criteria: (1) Articles published in Google Scholar, national and international proceedings, Sinta; (2) Articles using experimental research methods; (3) Articles which are quantitative research and meet effect size statistical data.

This article is carried out by providing tabulation of data to make it easier when doing a meta-analysis. To analyze the data using effect size namely: (1) Equation of effect size of one sample group, if the average pretest, average posttest, and standard deviation are included; (2) Equation of effect size of the two groups, if the average experimental group, the control group and the standard deviation are included; (3) Equation of effect size of the two-group design, if the average pretest, posttest and standard deviation of the two groups are known; (4) Equation of effect size, if the standard deviation are not stated then it can be done by using t-count and the number of students of experimental group and control group [10].

The following are criteria for *effect size*:

**Table 1.** Effect Size Criteria (ES)

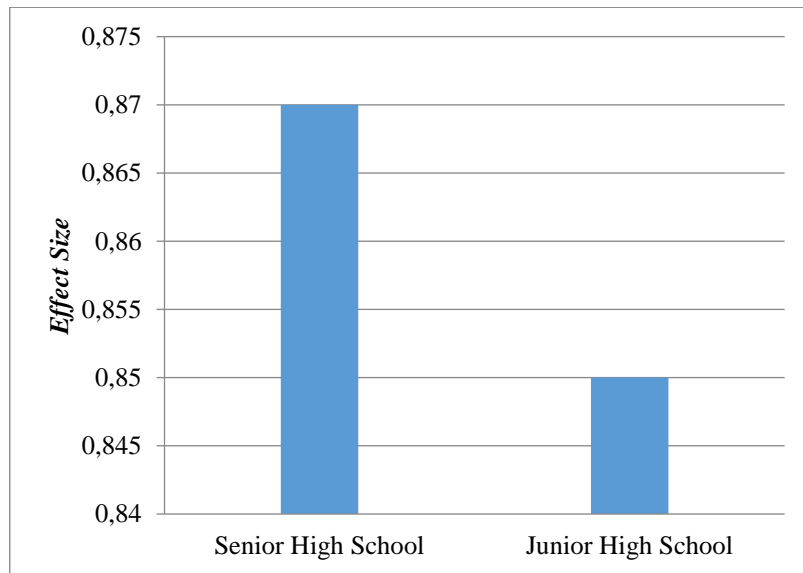
No	<i>Effect Size</i>	<i>Criteria</i>
1	$ES \leq 0.15$	Very Low
2	$0.15 < ES \leq 0.40$	Low
3	$0.40 < ES \leq 0.75$	Currently
4	$0.75 < ES \leq 1.10$	High
5	$1.10 < ES \leq 1.45$	Very High

### III. RESULT AND DISCUSSION

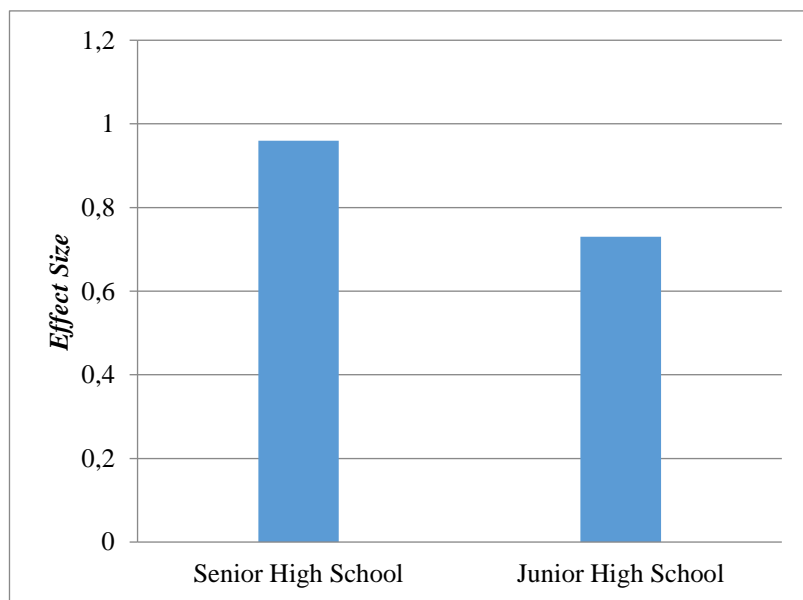
#### A. Result

The data examined in this study were 20 articles, including 15 national articles and 5 international articles. From the articles that has been analyzed, the results of this study are grouped into 3, namely based on education level, based on material units, and based on the learning model used. The following are the results of the research:

#### 1. Based on the education level



(a)

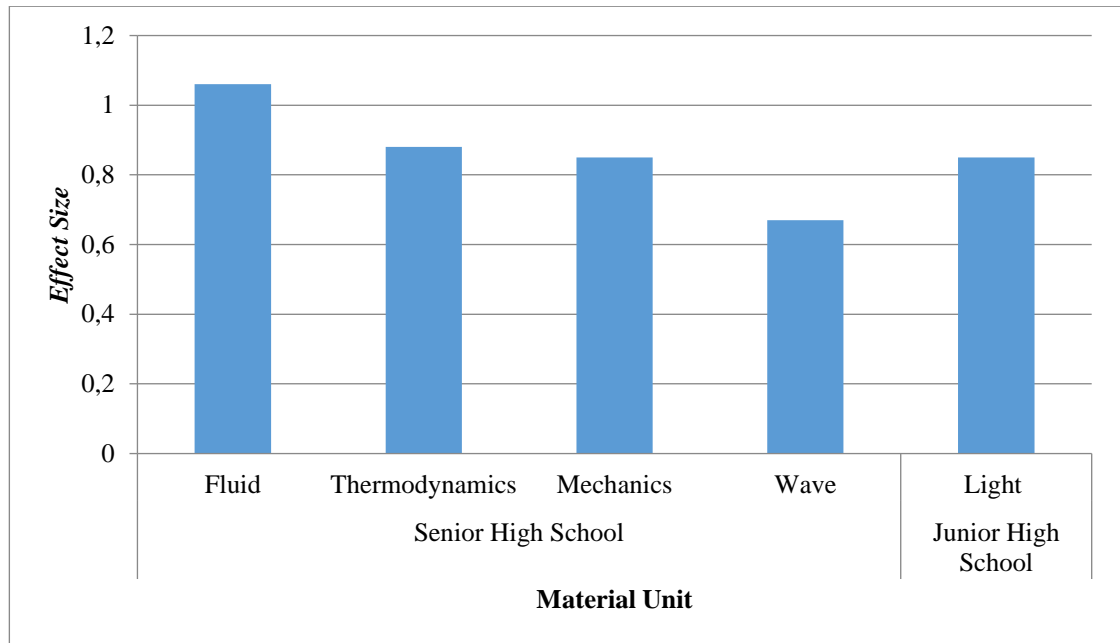


(b)

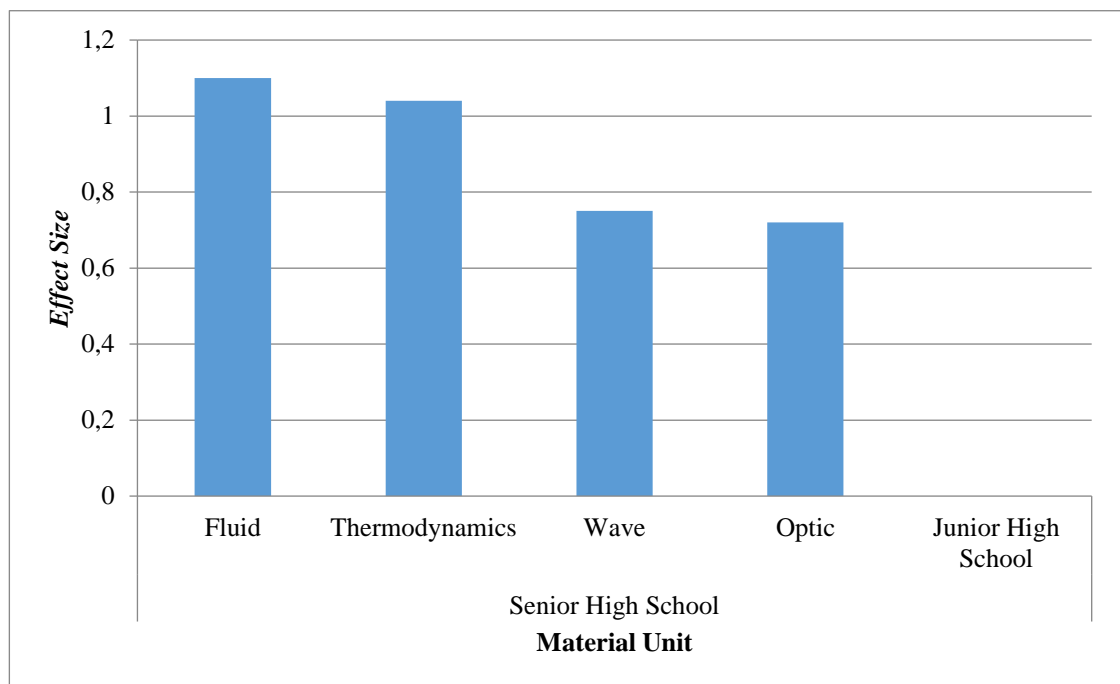
Fig. 1. (a) Critical Thinking Skills of "a" and (b) Creative Thinking Skills of "b"

It can be concluded that from the high school and junior high school levels the use of worksheets for critical and creative thinking skills result in the calculation of effect size, namely the high criteria. So that the use of worksheets have a significant effect both at the education levels, but when compared to the effect sizes to value, senior high school is higher than junior high school.

2. Based on the material unit



(a)

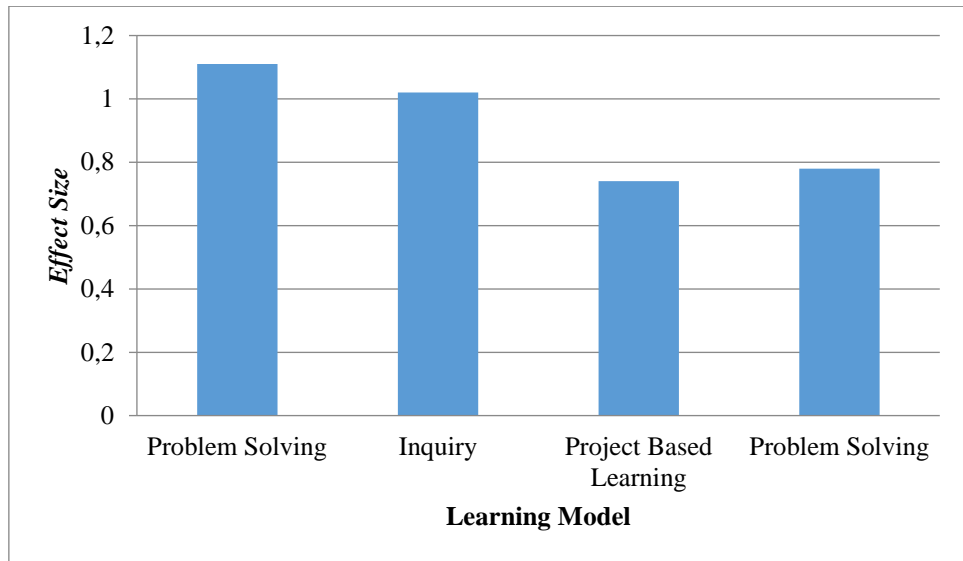


(b)

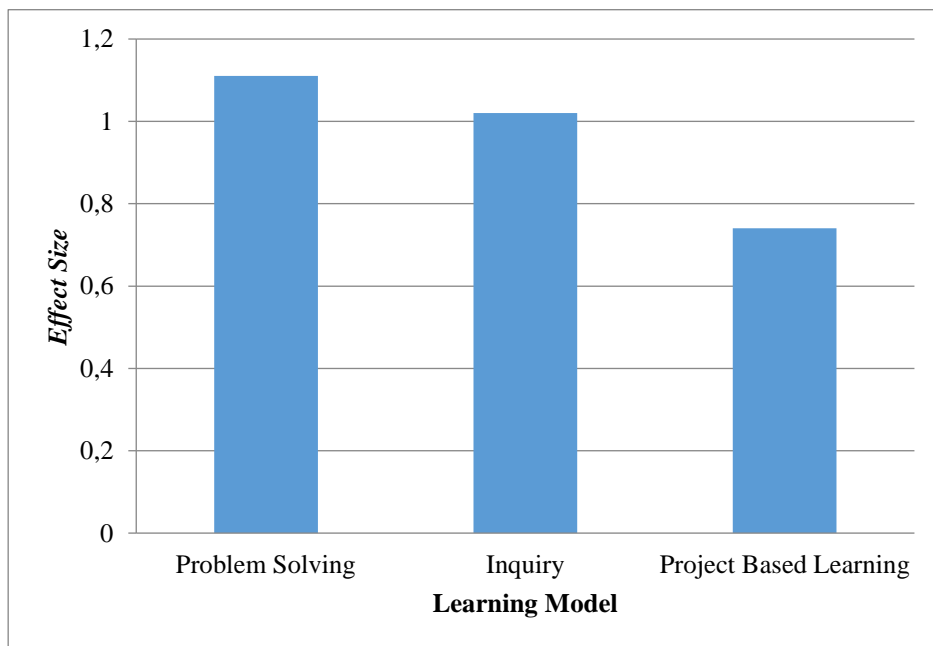
**Fig. 2.** (a) Critical Thinking Skills of “a” and (b) Creative Thinking Skills of “b”

It can be seen that for the senior high school level, the effect of worksheets on critical thinking skills is the highest effect size value, namely in the fluid material unit with 1.06 high category, and the junior high school level, namely in the light material unit with an effect sizes value of 0.85 in the high category. Furthermore, the high school level for creative thinking skills is the highest, namely the fluid material unit with an effect size value of 1.1 very high categories, while there is none for the material unit at the junior high school level. So it can be concluded that the unit of fluid matter has a significant effect on the high school level and the light material unit for the junior high school level.

3. Based on the learning model



(a)



(b)

Fig. 3. (a) Critical Thinking Skills of “a” and (b) Creative Thinking Skills of “b”

It can be seen that the effect of worksheets on critical thinking skills based on the model used is using a cooperative model with an effect size value of 0.98 in the high category. Furthermore, for effect of worksheets on creative thinking skills, the highest effect size value uses a problem-solving model, which is a 1.11 very high category. It can be stated that the use of worksheets with cooperative and problem-solving models has a significant effect on improving students' thinking skills.

*B. Discussion*

The first result is the effect of using worksheets on critical and creative thinking skills based on education level indicators. Judging from the effect size value, the worksheets have a positive influence. The results of the categories obtained from each level of education, namely for critical thinking skills are at high for the high school level with an effect size value of 0.87 while for junior high school the effect sizes to value is 0.85 with a high category. The effect of using worksheets on creative thinking skills has a positive influence both at the

junior high and high school levels. From the results of the effect size obtained in the high category, namely at the high school level with an effect size value of 0.96 in the high category. At the junior high school level with an effect size value of 0.73 the medium category. These results are relevant to other research that student worksheet has a good effect on the senior high school level [11]. These results indicate that the effect of using worksheets on critical and creative thinking skills is equally effective against high school and junior high school levels. However, when compared to the effect size value, the high school level is higher than the junior high school level. This finding is in line with the opinion that worksheets can build students' critical thinking skills in learning physics [12].

The second result achieved are the influence of worksheets on critical and creative thinking skills in terms of subject matter units. In this indicator, the researcher groups the material into several material units, namely fluids, thermodynamics, mechanics, and vibrations and waves according to the level of education. Based on the results of the meta-analysis in terms of material units, the effect sizes results obtained that the use of worksheets for high school critical thinking skills based on material units have the highest value of the fluid material unit with a value of 1.06 in the high category. In accordance with the results of other studies that student worksheets with fluid materials can improve critical thinking skills [13]. Then on the thermodynamics and mechanics material unit with effect size values are 0.88 and 0.85 in the high category. And at the junior high school level, based on the material unit, namely light with an effect size value of 0.85, the high category. Meanwhile, the use of worksheets for creative thinking skills based on the subject matter unit have the highest score of the fluid material unit with an effect size value of 1.10 in the high category. This is by the opinion that the fluid material unit provides many facts that often occur to students' lives [14]. Likewise with the thermodynamics material unit at the junior high or high school education level. From the results of the average effect size obtained in the high category, it means that the use of worksheets have a significant effect on the physics learning process because it can grow students' critical and creative thinking skills based on the material. It can be interpreted that the use of worksheets are very well used in learning physics.

The third result achieved are the effect of using worksheets on critical and creative thinking skills based on the learning model. Based on the results of the meta-analysis of the effect size of the use of worksheets based on the learning model, it was found that the cooperative model were used to improve critical thinking skills with the highest effect size to value, namely 0.98 in the high category. Furthermore, problem-based learning models, inquiry models, and problem-solving models with effect size values of 0.94, 0.83, and 0.78 are in the high category. This is by what was stated that the cooperative model are due to the advantages it has, namely in the teaching and learning process students are required to think critically independently and together [15]. For effect of worksheets on creative thinking skills, the highest in the problem-solving model with an effect size of 1.11 is in the very high category. This is in accordance with other studies that the problem solving model has an effect on the achievement of student competencies [16]. Furthermore, the inquiry models and project-based learning with effect size values of 1.02 and 0.74 are in the high category. Thus, it means that the use of worksheets using a learning model are very influential at both the junior high and high school levels.

#### IV. CONCLUSION

The results of the meta-analysis research concluded that the effect size value of the use of worksheets on critical and creative thinking skills based on education level was 0.87 in the high category and 0.96 in the high category. It can be said that the student worksheets have a significant effect on the junior and senior high school levels. However, when compared based on the value of the effect size, the use of students' worksheets is more influential at the high school level than at the junior high school level. The effect size value is the effect of using worksheets on critical and creative thinking skills based on the material unit, namely the fluid material unit with an effect sizes value of 1.06 and 1.10 in the high category. It can be said that the influence of student worksheets has an effect when viewed from the material unit. The value of the effect size of the use of worksheets on critical thinking skills is in the cooperative model of 0.98 in the high category and creative thinking skills in the problem-solving model with an effect size of 1.11 in the very high category. It can be said that the influence of student worksheets has a good effect based on the learning model used.

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