



Effects of Thematic Model Science Student Worksheet on Student's Learning Outcomes: a Meta-Analysis

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Abstrak

Penerapan LKS IPA model tematik merupakan solusi mengatasi permasalahan dalam pembelajaran IPA, seperti rendahnya hasil belajar siswa. Namun pada penelitian terkait tersebut belum ada kajian komprehensif mengenai pengaruh LKS IPA model tematik terhadap hasil belajar siswa SMP. Penelitian ini bertujuan untuk menganalisis pengaruh penerapan LKS IPA model tematik terhadap tingkat kelas, materi pembelajaran, dan hasil belajar siswa pada aspek pengetahuan. Oleh karena itu, untuk mengetahui pengaruh LKS IPA model tematik digunakan metode meta-analisis. Analisis data yang dilakukan menghasilkan penelitian yaitu LKS IPA model tematik dari dua puluh penelitian sejenis mempunyai pengaruh yang signifikan terhadap hasil belajar aspek pengetahuan siswa SMP, sampai tingkat kelas VIII pada materi cahaya. Kesimpulannya, LKS IPA model tematik mendukung hasil belajar siswa dalam pembelajaran IPA.

Kata Kunci: *Meta Analisis, Model Tematik, Lembar Kerja Siswa.*

Abstract

The application of thematic model science worksheets is solution overcoming problems science learning, like low student learning outcomes. However, in this related research, there has been no comprehensive study on the effect of thematic model science worksheets on the learning output of junior high school students. For this study intention to analyze the effect of the application of thematic model science worksheets on grade level, learning materials, and student learning output in the aspect of knowledge. Therefore, to find out the effect of the thematic model science worksheets, a meta-analysis method was used. The data analysis uncovered conducted, results of research can be stated. Thematic model science worksheets from twenty similar studies have a significant influence on learning output of junior high school students' knowledge aspects to the VIII grade level on the materials of light. In conclusion, the thematic model science worksheets support student learning output in science learning.

Keywords: *Meta-Analysis, Thematic Model, Student Work Sheet.*

INTRODUCTION

A process of individual interaction with the environment that causes changes in behavior is education. Education aims to develop abilities and shape individual personalities through various processes in the form of teaching, training and guidance. Education at this time is required to be able to equip students with 21st century competencies. The goal of 21st century national education in Indonesia is to form human resources (HR) to become independent, willing, and

capable individuals to create a nation that can compete globally (Mardianti, 2020:91-100).

Education should be able to produce human resources who have 21st century competencies, namely creativity, critical thinking, communication, and collaboration, known as the "Four Cs" (Etrina, 2018). The basic principle in 21st century learning must be student-centered to practice teamwork, problem solving, and doing assignments (Asrizal, 2022:61-67). Thus, students need these skills to achieve success in study, daily life, and the world of work.

The government has made various endeavor to meet the demands of education in the 21st century. One of the government's efforts to improve content standards is curriculum development. The curriculum continues to be developed until the most recent one is the 2013 revised edition of the 2017 curriculum. The 2013 curriculum at the junior high school education level in science learning is carried out with the integrative concept of science or integrated science. Through science learning, it is hoped that students can gain scientific knowledge, can work together in teams, can add strength to receive, store, and apply the concepts they learn (Trianto, 2014).

Thematic model science learning is a form of learning that combines several science concepts and studies in a particular subject. Thematic model science learning has several advantages, including: time efficiency, students can see meaningful relationships between concepts, improve students' thinking skills, present applications/applications about the real world experienced in everyday life that are close to students, making it easier for students to understand concepts, improve and enhance students' learning motivation. Thus, students are trained to be able to find out for themselves various concepts that are studied thoroughly, meaningfully, authentically and actively in learning activities (Pusat kurikulum, 2016). Student worksheets are a form of teaching materials that can be utilized to support the learning process. The utilization of worksheets can make it easier for teachers to carry out learning and help students make learning activities more focused Ni'mah, 2013:149-156).

The reality in the field hasn't described the expected conditions. The solution chosen by previous researchers to overcome this issue needed to be applied an thematic model science worksheet. The use of this thematic model science worksheet is expected to improve the learning output of junior high school students. The solutions provided by previous researchers have weaknesses or limitations in conducting research. Weaknesses or limitations in previous research include: (1) the subject matter applied in the study is limited, (2) the type of thematic model science learning used in the study is only one type, (3) the curriculum component that is integrated in learning only emphasizes one component. Thus, the solution to this limitation is the existence of further research on thematic model science student's worksheets.

The first theoretical study of this solution is the student worksheet. Student worksheet is a student guide that is used to carry out investigation or problem solving activities (Trianto, 2014). Another understanding of student worksheet is sheets containing assignments that must be done by students

(Prastowo, 2012). Activity sheets often consist of stages or directions for completing a job, and the activity itself must be clear about the fundamental skills that must be attained (Khairunnisa, 2016:105-114). Student worksheet is also one of the learning tools used to direct pupils while they complete exercises or work both individually and in groups (Utami, 2014:487-493).

The second theoretical study is an integrated thematic model of science learning. Thematic learning defined as an integrated learning that uses one theme to give meaningful experiences by tying together several fields of knowledge (Ain, 2017:919-928). In thematic model science learning, a concept or discussed themes from different angles in the field of study in the field of science studies so that students find their own concepts that are studied holistically (Utami, 2014:487-493).

Some of the meta-analytical studies that have been carried out have not focused entirely on the thematic model science worksheets, there is no recent meta-analysis research on the use of thematic model science worksheets on the learning output of junior high school students. With the problems that have been described, the researchers conducted a study on "Effects of Thematic Model Science Student Worksheet on Student's Learning Outcomes: A Meta-Analysis". The This study's objective is to analyze the effect of thematic model science worksheets on student learning output in the aspect of knowledge, then based on grade level and based on subject matter.

METHOD

This type of research is a meta-analysis because this research uses existing studies and has been used by other researchers. There are five criteria for articles used in this study. First, the selected articles have the theme of thematic model science learning. Second, articles consist of national journals and international journals, third, selected articles published in the last 10 years, namely from 2010-2020. Fourth, the selected article is the use of thematic model science student worksheet. Fifth, the selected articles review the effect of thematic model science student worksheets on many topics pertaining to knowledge. The articles analyzed in this study were 20 articles that discussed thematic model science worksheets in junior high school science learning consisting of 16 national articles and 4 international articles.

The steps in conducting a meta-analysis in this study are six steps. The steps of meta-analysis research are 1) identifying problems, 2) collecting available literature, 3) calculating effect sizes, 4) calculating heterogeneity and hypotheses, 5) analyzing intermediate variables, 6) drawing conclusions and interpreting research results.

Data analysis techniques are needed in processing data in research. The quantitative data from several research are combined using meta-analysis techniques to create a comprehensive synthesis of the empirical knowledge about a certain subject. The data analysis method employed in this study is a quantitative approach through the calculation and analysis of the data already in the article. Data analysis techniques in determining the *effect size* can use several equations in Table 1.

Table 1. Calculation *Effect Size*

Statistical Data	Formula	Description
Average in one group	$ES(d) = \frac{\bar{X}_{post} - \bar{X}_{pre}}{SD_{within}}$	ES(d) = <i>Effect Size</i> Cohen's \bar{X} = Average Value SD = Standard deviation r = Correlation Coefficient t = t-test results n = number of groups
Average in each group (posttest only)	$ES(d) = \frac{\bar{X}_E - \bar{X}_C}{SD_{within}}$	
Average in each group (pretest-posttest)	$ES(d) = \frac{(\bar{X}_{post} - \bar{X}_{pre})_E - (\bar{X}_{post} - \bar{X}_{pre})_C}{SD_{within}}$	
t-test results	$ES(d) = t \sqrt{\frac{1}{n_e} + \frac{1}{n_c}}$	
correlation coefficient	$ES(d) = \frac{2r}{\sqrt{1-r^2}}$	

After obtaining *effect size*, the results can be interpreted into categories in Table 2.

Table 2. Classification *Effect Size*

ES	Category
$ES \leq 0,15$	Negligible
$0,15 < ES \leq 0,40$	Low
$0,40 < ES \leq 0,75$	Medium
$0,75 < ES \leq 1,10$	High
$ES > 1,10$	Very high

RESULTS AND DISCUSSION

Effect of Thematic Model Science Student Worksheet on Knowledge Aspects

The results of the first study are related to the effect of thematic model science student worksheet on student learning output in terms of knowledge aspects. The results of the heterogeneity test of the influence of the thematic model science student worksheet on student learning output in the knowledge aspect show that the calculation of the hypothesis test is more appropriate using the *effect*. The results of the data processing of the hypothesis test of the influence of the thematic model science student worksheet on student learning output in aspects Knowledge can be seen in Table 3.

Table 3. Hypothesis Test Results on Knowledge Aspect

Code Article	Effect Size Y_i	Variance V_{yi}	Variance between antar Articles T^2	Total Variance $V_{yi} + T^2$	$W_i *$	$W_i * Y_i$
A1	0,504	0,063	0,730	0,793	1,261	0,635
A2	5,688	0,535	0,730	1,265	0,790	4,495
A3	2,004	0,098	0,730	0,828	1,207	2,419
A4	0,533	0,063	0,730	0,793	1,261	0,673
A5	0,476	0,038	0,730	0,768	1,302	0,620
A6	0,874	0,049	0,730	0,779	1,284	1,122
A7	1,561	0,080	0,730	0,810	1,235	1,927

A8	1,314	0,074	0,730	0,804	1,243	1,633
A9	1,274	0,074	0,730	0,804	1,244	1,586
A10	1,047	0,070	0,730	0,800	1,251	1,310
A11	0,233	0,035	0,730	0,765	1,308	0,305
A12	1,185	0,072	0,730	0,802	1,247	1,478
A13	1,384	0,072	0,730	0,802	1,248	1,727
A14	0,415	0,064	0,730	0,794	1,259	0,522
A15	3,748	0,295	0,730	1,025	0,976	3,656
A16	0,760	0,068	0,730	0,798	1,254	0,953
A17	3,035	0,125	0,730	0,855	1,169	3,549
A18	0,455	0,061	0,730	0,791	1,265	0,575
A19	-0,939	0,064	0,730	0,794	1,259	-1,183
A20	0,532	0,077	0,730	0,807	1,238	0,659
Total					24,300	28,660
M*					1,179	
V_{M*}					0,041	
SE_{M*}					0,203	
LL_{M*}					0,782	
UL_{M*}					1,577	
Z*					5,814	
p-value one-tailed test					0,000	
p-value two-tailed test					0,000	

Considering the analysis' findings using the RE model, the average *effect* (M^*) is 1.179. This value indicates that there is a difference *posttest* and *pretest* scores of 1.179. The interpretation of the results of the M^* (positive difference in value) also shows that the *posttest* is higher or better than the *pretest*. The results of testing the null hypothesis (H_0 : *effect size* = 0) indicate that the null hypothesis is rejected because the *p-value* obtained is 0.000 which is smaller than the value of (0.05). Thus, it can be concluded that the thematic model science worksheets have a significant influence on student learning output in the aspect of knowledge based on data from 20 similar research articles.

The Effect of Thematic Model Science Student Worksheet in terms of Class Levels

The results of the second study are related to the effect of integratedscience student worksheet with thematic model on student learning output in terms of class level. Articles that discuss the influence of thematic model science worksheets on student learning output in class VII have eight articles and class VIII there are twelve articles. The thematic model science worksheets hypothesis testing in terms of class levels can be seen in Table 4.

Table 4. Hypothesis Test Results in terms of Class Levels

Class	Code Article	M^*	SE_{M^*}	LL_{M^*}	UL_{M^*}	p
VII	A7	0,897	0,364	0,183	16,11	0,014
	A11					
	A12					
	A13					
	A14					
	A17					
	A18					
	A19					
VIII	A1	1,355	0,241	0,882	1,828	0,000
	A2					
	A3					
	A4					
	A5					
	A6					
	A8					
	A9					
	A10					
	A15					
	A16					
	A20					

Considering the analysis' findings using the RE model, the average *effect* (M^*) at the seventh grade level is 0.897 with a 95% confidence interval ranging from 0.183 to 1.611. The results of the analysis for the average effect (M^*) at the VIII grade level is 1.355 with a 95% confidence interval ranging from 0.882 to 1.828. The results of testing the null hypothesis (H_0 : effect size = 0) for both class levels show that the null hypothesis is rejected because the p-value obtained is 0.014 and 0.000 is smaller than the value of (0.05). Thematic model science worksheets have a significant influence on the results student learning for both grade levels. However, when compared between the effect size two grade levels, class VIII has a higher summary effect size value than class VII. Thus, it can be seen that the thematic model science worksheets are more effective and have a more meaningful impact if they are applied to the VIII grade level.

Effect of Thematic Model Science Student Worksheet in terms of subject matter

The results of the third study are related to the effect of thematic model science worksheets on student learning output in terms of subject matter. The results of the hypothesis test were obtained from the calculation of the effectsize of each article which was processed using the fixed effect (FE) and random effect (RE) model. The value of the hypothesis test in terms of the subject matter can be observed in Table 5.

Table 5. Hypothesis Test Results in terms of the Subject matter

Subject	Code Article	M^*	SE_{M^*}	LL_{M^*}	UL_{M^*}	p
Motion	A1	1,851	0,495	0,880	2,822	0,000
	A2					
	A3					
	A6					
	A8					

Pressure Utilization	A5 A16	0,578	0,156	0,273	0,883	0,000
GLSTSGPS	A4	0,533	0,251	0,041	1,026	0,034
Energy and Organizational	A7	1,561	0,283	1,006	2,115	0,000
Systems Health	A9	1,274	0,271	0,742	1,806	0,000
Respiratory and excretory	A10	1,047	0,264	0,530	1,564	0,000
Waste	A11	0,233	0,186	-0,132	1,252	0,211
Environmental pollution	A12	1,185	0,268	0,660	1,711	0,000
Density of substance	A13	1,384	0,268	0,860	1,908	0,000
Light	A15	3,748	0,543	2,683	4,812	0,000
Characteristics of living things	A17	3,035	0,354	2,341	3,729	0,000
Energy	A18	0,455	0,246	-0,029	0,938	0,065
Why can my body feel temperature changes	A19	-0,939	0,253	-1,435	-0,443	2,000
Lens	A20	0,532	0,278	-0,014	1,077	0,056

From the data in Table 8 it can be described that the outcomes from the meta-analysis of influence of thematic model science worksheets on junior high school students learning output have different effects ranging from categories can be ignored to very high in junior high school science subject matter. The results of testing the null hypothesis (H_0 : *effect size* = 0) on 10 subject matter shows that the null hypothesis is rejected because the *p-value* obtained is smaller than the value of (0.05). While the results of testing the null hypothesis (H_0 : *effect size* = 0) on 4 subject matter shows that the null is recognized as a theory because the *p-value* obtained is greater than the value of (0.05). It is possible to state that the thematic model science worksheets have a significant influence on the learning output of junior high school students in each of these subject matter except for waste material, energy, why my body can feel changes in temperature, and lenses. Considering the average value of the *effect* (M^*) obtained, the highest value is in the light material. Therefore, it can be seen that the application of thematic model science worksheets is the most effective in improving the learning output of junior high school students on light material.

This study was carried out to look at the overall *effect size* of the application of the thematic model science worksheets on the learning output of junior high school students seen from several moderator variables. The first result achieved is the effect of thematic model science worksheets in science learning in terms of learning outcomes. Thematic model science student worksheet by giving a very high influence on the knowledge aspect. Trianto (2014) explained that one of the advantages of thematic model science learning is that it can improve learning output students and shorter learning time because in one meeting they can learn several fields of study at once (Trianto, 2014). Student worksheet can affect student learning output if the student worksheet contains integrated learning characteristics consisting of holistic (whole), meaningful, authentic and active (Ananda, 2018). This is in line with Asrizal (2020) who says that learning with the thematic model is characterized as coordinated discovering that utilizations

subjects to interface a few materials that help students to effectively find logical ideas and standards in an all encompassing, significant, and real way (Asrizal, 2020:97-104).

Thematic model science learning can expand understudies' advantage and inspiration to learn. The use of thematic model science worksheets is designed for meaningful science learning so that in learning activities students will be active in solving problems related to real life (Bariroh, 2014). Based on the results of research conducted by Nabillah (2019) also stated that the thematic model science worksheets contain material that emphasizes the learning experience, encouraging student activity so that learning becomes more interesting and fun. Thus, through the application of thematic model science worksheets students can relate the experiences and concepts they have learned to understand and apply these concepts to other phenomena so as to improve student learning outcomes.

The second result achieved is that the thematic model science worksheets in science learning in terms of grade level have a high influence on the seventh grade level and very high on the eighth grade level. The thematic model science worksheets in science learning both have a positive influence on grades VII and VIII. However, the thematic model science worksheets are more effective and have a more meaningful impact if they are applied to the VIII grade level. This shows that the higher the grade level the more influential on the development of student knowledge.

The outcome of the educational experience is affected by the level of students' thinking abilities. According to Piaget (in Nuroso, 2010), the level of cognitive development of junior high school students is at the formal operational stage who is able to reason without having to deal with direct objects or events because students are over 11 years old (Nuroso, 2010:35-46). Ibda (2015) explains that the level of human intellectual development affects maturity, physical experience, logical experience so that students with higher grade levels have more learning experiences than students with lower grade levels (Ibda, 2015: 27-38). So that student learning output are higher in class VIII because they have gone through the basic education level and have thought to the youth level.

The third result achieved is the influence of thematic model science worksheets in science learning in terms of material aspects which have a very high influence on the materials of Motion, Energy and Organizational Systems, Digestive Health, Environmental Pollution, Density of Substances, Light, and Characteristics Living things. Garbage matter had a low impact, whereas why my body could sense changes in temperature had a negligible effect. The thematic model science worksheets that were developed were considered very good and positive by the teachers so that they could be a guide for science learning in schools and teachers no longer carried out separate learning into biology, physics, and chemistry but had been integrated into thematic model science learning (Muhafid, 2013:140-148). Thematic-based integrated learning that uses themes to connect several different disciplines tends to be interesting and can improve student learning output because students are more motivated to receive

lessons in class (Risma, 2020:42-49). Based on the average value of the effect (M^*) obtained, the highest value is in the light material. Based on the results of research conducted by Janawi (2015) it is explained that there are significant results due to the influence of thematic model science worksheets on student learning output in light material (Janawi, 2015). A similar study conducted by Khairunnisa (2016) stated that the thematic model science worksheets on the topic of light were proven to be effective for students to use in learning (Khairunnisa, 2016:105-114). This is because the characteristics of light material are materials that can be observed by students directly and are commonly found in everyday life. Therefore, it can be seen that the application of thematic model science worksheets is the most effective in improving the learning output of junior high school students in light.

CONCLUSION

Regarding the findings of the meta-analysis, we might thus conclude. First, thematic model science worksheets from twenty similar studies have a significant influence on learning output of junior high school students' knowledge aspects. Second, thematic model science worksheets have a significant influence on learning outputs students if applied to the VIII grade level. Third, the use of thematic model science worksheets has a significant influence on the materials of light. Thus, the thematic model science student's worksheets can be used as science student worksheets in the teaching and learning process in schools.

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