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The Effectiveness of SIL (Science Integrated Learning) Implementation Model to Improve Students' Critical Thinking in Elementary School

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Abstract:- This study aims to find the effectiveness of learning with *Science Integrated Learning* (SIL) model to create students' critical thinking skills of elementary school. This study used the improvement of 4D (Thiagarajan et al, 1974) models which are defining, planning, improveing and disseminating a pre-experimental research design, one group pre-test post-test. The participants were 5th grade elementary school students as the state Elementary school percobaan in Surabaya, East Java. The results showed that this learning improvement was improved effectively for enhancing students' critical thinking skills. This was proved by the results of classical completeness on individual completeness from pretest was 10% and posttest which was increased by 96% and the average N-Gain was 0.61% with the medium category. From the results above, it can be concluded that the *Science Integrated Learning* (SIL) method is effective in learning so that it can improve students' critical thinking skills.

Keywords:- *Critical Thinking, Science Integrated Learning (SIL), Model.*

I. INTRODUCTION

Critical thinking is the ability to think reflectively which is reasonable or based on the logical thinking to determine what will be done or believed (Ennis, 1985). Critical thinking creates the ability of someone to understand some arguments of values, understand the existence of inferences, and be able to interpret the problem (Hartati, 2013). Corich (2011) states that critical thinking is known as an important skill for millennial in the 21st century and education experts agreed that encourage the students to think critically is an important point of education system.

The results of *Program for International Students Assessment (PISA)* found that Indonesia's average score in 2012 to 2015 was increased, that was on science and mathematics were 11 points and reading was 1 point. Although the average score of achievement of Indonesian students for science, reading, and mathematics in rank of 62, 61 and 63 from 69 countries where was evaluated meanwhile the improvement of this result also show the improvement of Indonesian Education Based on PISA in 2005, especially in science, the assessment of *belief about the nature and origin of scientific knowledge* is still in low score which is only 16%. This shows that Indonesian students lack of the ability to integrate information, draw conclusions, and generalize their knowledge, the ability to improve investigations, think critically, explain and apply knowledge about science in complex situations.

The expected learning model which is able to create students for improving their critical thinking skills is *Science Integrated Learning* (SIL). *Science Integrated Learning* (SIL) is the improvement of an inquiry models (Carin and Sund (1982) with the *Science Technology Society* (STS) which is improveed by Carin (1997), it was built from his previous knowledge, then it was integrated for understanding the concept and application of the science concept. Parmin's (2017) found that the SIL method has an influence on the students' worksheet of Science Department that is why the effect of SIL implementation in the long-term activity will help the students to solve the problem by applying science in integrated manner.

The successful of SIL implementation learning model in classroom learning activities is interesting for the researchers to analyze how the effectiveness of SIL learning models in science to create critical thinking skills of fifth grade students. Based on the background knowledge of this research, the researchers were encouraged to conduct this study entitled "The Effectiveness of Science Integrated Learning (SIL) Implementation Model to improve Students' Critical Thinking in Elementary School".

II. METHOD

This study belongs to the improvement research of Thiagarajan, Semmel, and Semmel (1974), that is the 4D model (four D Model) which consisted of define, design, improve and disseminate. This study improves Learning Tools with Science Integrated learning (SIL) model to improve Critical Thinking of fifth grade Elementary School Students on *perpindahan kalor* material.
The research was conducted at Percobaan state elementary school Surabaya. The study was conducted in fifth A grade and Fifth B grade of academic year 2018/2019, starting from October 2018 to July 2019. The subjects were students of fifth A and B grade of Percobaan state elementary school student of Surabaya in the academic year 2018/2019 which were 49 students consisting of 19 male students and 30 female students.

The design of this study used pre-experiment of *One Group Pre-test and Post-Test Design*. The data collection was taken twice that is before the experiment or pretest

(O1) and after the experiment or posttest (O2). This study used the research design as follows:

O_1 X O_2 (Arikunto, 2006)

In which:

O_1 : giving initial test (*pre test*)
O_2 : giving final test (*post test*)
X : *Science Integrated Leraning* (SIL) treatment

Data analysis techniques are carried out for data processing that has been obtained so that the learning process that is used in this learning activity can be known by its effectiveness. The Data result which was analyzed, consisted of student learning outcomes and students' critical thinking skills analysis.

This study will be analyzed some data as follows:

A. Learning Effectiveness Analysis

➢ *Students learning outcome analysis*

- *Individual Completeness*

The completeness of an individual student can be said to be complete if the percentage of indicators is in accordance with the value of the completeness of the Minimum Criteria for minimum completeness criteria of Percobaan state elementary school Surabaya, which is 75% from students in one class where get a score of ≤ 72.

$$\text{Individual Completeness} = \frac{\sum \text{score obtained}}{\sum \text{score maximum}} \text{ x } 100\%$$

(Kemendikbud, 2014c)

- *Classical Completeness*

Class completeness (classical) is said to be competent if the number of students who complete study is> 85% from the whole students. Classical completeness can be calculated using the formula below:

$$\text{Classical Completeness} = \frac{\sum \text{student who complete}}{\sum \text{all the students}} \text{ x } 100\%$$

(Kemendikbud, 2014c)

➢ *Critical Thinking Skills Analysis*

- *The Level of Difficulty Question Analysis*

The level of question difficulty is determined based on the number of questions answered correctly by students who divided by the number of students. The Systematically is written as follows:

$$P = \frac{B}{J}$$ (Masriyah, 1999:8)

Information:

P : Difficulty Index
B : the number of students' answer
J_s : the number of respondent

Difficulty indexes are classified as follows:

P = 0,00 until 0,30 difficult question
P = 0,30 until 0,70 medium question
P = 0,70 until 1,00 easy question. (Masriyah, 1999: 11)

B. Sensitivity Question Items Analysis

This test is used to determine the effectiveness of the question. Questions are said to be effective if it is answered correctly by more students after the teaching and learning process takes place. To calculate the sensitivity, index the effect of the teaching and learning process (S) can be calculated by statistics:

$$S = \frac{B_{SS} - B_{SB}}{T}$$ (Kardi, 2002: 137)

Information:

B_{ss} : the number of students who answer correctly after the learning process takes place
B_{SB} : the number of all students who answer correctly before the learning process takes place
T : amount of students

The maximum sensitivity index price is 1.00 and the minimum sensitivity index is zero. The greater sensitivity index shows a high level of sensitivity and shows the level of sensitivity to the effects of teaching, while the low sensitivity index has two possibilities, that is the first possibility is items that are less able to measure teaching and the second possibility is the teaching carried out by the teacher is not effective. Teaching is called as effective if the sensitivity level is between 0 and 1.00.

C. Student Critical Thinking Knowledge

From the results of the pretest and posttest, the data is obtained then it was analyzed by using N-Gain to determine the improvement of students' critical thinking learning after using the improveed tools (Hake, 1999).

$$N\text{-Gain} = \frac{\text{Spost} - \text{Spre}}{\text{Smax} - \text{Spre}}$$

Information:

S_{post} = posttest score
S_{pre} = Pretest score
S_{max} = Maximum score

Then from the results of the calculation of N-Gain then convert it to the criteria in table 1.

***N−Gain* Score**	**Normalized *Gain***
0,70 < N − Gain	High
0,30 ≤ N – Gain ≤ 0,70	Moderate
N−Gain < 0,30	Low

Table 1:- *N-Gain* Criteria

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III. RESULT

Individual completeness was analyzed from the results of the pretest and posttest by using a comparison of the results which is obtained from student learning outcomes. The completeness criterion is 75 according to the KKM that has been set by the school, that is the average score of the individual completeness pre test scores is 53, while the average score for the completeness of the post test is 83.

No	Name	S_{pre}	Minimum completeness criteria KKM= 75	S_{post}	Minimum completeness criteria KKM= 75
1	A1	58	Incomplete	92	Complete
2	A2	25	Incomplete	83	Complete
3	A3	42	Incomplete	75	Complete
4	A4	42	Incomplete	83	Complete
5	A5	67	Incomplete	83	Complete
6	A6	33	Incomplete	92	Complete
7	A7	50	Incomplete	83	Complete
8	A8	75	Incomplete	92	Complete
9	A9	42	Incomplete	83	Complete
10	A10	42	Incomplete	92	Complete
11	A11	58	Incomplete	75	Complete
12	A12	50	Incomplete	92	Complete
13	A13	50	Incomplete	75	Complete
14	A14	67	Incomplete	83	Complete
15	A15	58	Incomplete	75	Complete
16	A16	33	Incomplete	83	Complete
17	A17	50	Incomplete	92	Complete
18	A18	58	Incomplete	83	Complete
19	A19	50	Incomplete	83	Complete
20	A20	17	Incomplete	67	Uncompleted
21	A21	42	Incomplete	75	Complete
22	A22	50	Incomplete	75	Complete
23	A23	58	Incomplete	75	Complete
24	A24	67	Incomplete	75	Complete
25	A25	50	Incomplete	83	Complete
26	A26	67	Incomplete	83	Complete
27	A27	67	Incomplete	83	Complete
28	A28	8	Incomplete	67	Uncompleted
29	A29	75	Complete	83	Complete
30	A30	42	Incomplete	75	Complete
31	A31	67	Incomplete	92	Complete
32	A32	75	Complete	83	Complete
33	A33	42	Incomplete	83	Complete
34	A34	42	Incomplete	75	Complete
35	A35	75	Complete	75	Complete
36	A36	58	Incomplete	83	Complete
37	A37	50	Incomplete	92	Complete
38	A38	58	Incomplete	83	Complete
39	A39	58	Incomplete	83	Complete
40	A40	67	Incomplete	83	Complete
41	A41	50	Incomplete	83	Complete
42	A42	58	Incomplete	100	Complete
43	A43	42	Incomplete	92	Complete
44	A44	50	Incomplete	92	Complete
45	A45	58	Incomplete	83	Complete
46	A46	67	Incomplete	83	Complete
47	A47	42	Incomplete	75	Complete
48	A48	75	Complete	92	Complete
49	A49	67	Incomplete	92	Complete
Average		**53**		**83**	
Classical completeness		**10%**		**96%**	

Table 2:- Individual Completeness Result

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Table 3 shows that 49 students who took the critical thinking test which were 32 students who received a moderate N-Gain score, 15 students who obtained a high N-gain score and 2 students who obtained a low N-Gain score.

No	Name	S_{pre}	S_{post}	<g>	*N-Gain*
1	A1	58	92	0,80	High
2	A2	25	83	0,78	High
3	A3	42	75	0,57	Moderate
4	A4	42	83	0,71	High
5	A5	67	83	0,50	Moderate
6	A6	33	92	0,88	High
7	A7	50	83	0,67	Moderate
8	A8	75	92	0,67	Moderate
9	A9	42	83	0,71	High
10	A10	42	92	0,86	High
11	A11	58	75	0,40	Moderate
12	A12	50	92	0,83	High
13	A13	50	75	0,50	Moderate
14	A14	67	83	0,50	Moderate
15	A15	58	75	0,40	Moderate
16	A16	33	83	0,75	High
17	A17	50	92	0,83	High
18	A18	58	83	0,60	Moderate
19	A19	50	83	0,67	Moderate
20	A20	17	67	0,60	Moderate
21	A21	42	75	0,57	Moderate
22	A22	50	75	0,50	Moderate
23	A23	58	75	0,40	Moderate
24	A24	67	75	0,25	Moderate
25	A25	50	83	0,67	Moderate
26	A26	66	83	0,50	Moderate
27	A27	67	83	0,50	Moderate
28	A28	8	67	0,64	Moderate
29	A29	75	83	0,33	Moderate
30	A30	42	75	0,57	Moderate
31	A31	67	92	0,75	Moderate
32	A32	75	83	0,33	Moderate
33	A33	42	83	0,71	High
34	A34	42	75	0,57	Moderate
35	A35	75	75	0,00	Low
36	A36	58	83	0,60	Moderate
37	A37	50	92	0,83	High
38	A38	58	83	0,60	Moderate
39	A39	58	83	0,60	Moderate
40	A40	67	83	0,50	Moderate
41	A41	50	83	0,67	Moderate
42	A42	58	100	1,00	High
43	A43	42	92	0,86	High
44	A44	50	92	0,83	High
45	A45	58	83	0,60	Moderate
46	A46	67	83	0,50	Moderate
47	A47	42	75	0,57	Moderate
48	A48	75	92	0,67	Moderate
49	A49	67	92	0,75	High
Average				**0,61**	**Moderate**

Table 3:- *N-Gain Result*

Information:

S_{pre} : pretest score
S_{pre} : pretest score
<g> : *N-Gain* score

Table 4 shows that there are three indicators that obtain moderate N-Gain values, that is indicators which recognize problems, collect and compile information needed and draw conclusions. While the other two indicators get high N-gain values, that is, each indicator determines ways that can be used to deal with problems and draw conclusions and similarities that are needed.

No	Indicator	No. Soal	Pre-test				Post-test				N-Gain	Category
			T	TT	%K	X (%)	T	TT	%K	X (%)		
1	Knowing the problem	1	25	24	51	41	47	2	96	77	0,60	**Moderate**
		8	15	34	31		28	21	57			
2	Determining the way of solving problem	3	30	19	61	63	47	2	96	95	0,86	**High**
		4	32	17	65		48	1	98			
		5	34	15	69		47	2	96			
		7	28	21	57		44	5	90			
3	Collecting and compiling information needed	2	24	25	49	49	39	10	80	80	0,60	**Moderate**
4	Data Analysis	6	31	18	63	63	44	5	90	90	0,72	**High**
5	Drawing the conclusion	9	30	19	61	61	43	6	88	73	0,32	**Moderate**
		10	29	20	59		43	6	88			
		11	17	32	35		30	19	61			
		12	15	34	31		28	21	57			

Table 4:- The Result of Critical Thinking Completeness Indicator

Information:

S_{post} : Posttest Score
S_{pre} : Pretest Score

IV. DISCUSSION

Table 2 shows the results of individual completeness from obtaining the pre-test and post-test scores. The determination of completeness criteria (KKM) that applied in Percobaan State elementary school of Surabaya in which students are declared to have completed their learning outcomes (individual completeness) when they reach 75 as the mastery limit of the material. Classical completeness also uses the minimum completeness criteria (KKM) provisions of Percobaan State elementary school of Surabaya and the class is called to be complete if there are ≥ 75% of students complete their studies in the class. Based on individual completeness results data can be obtained that in the pre-test as many as 4 students were declared as complete and 46 students who did not complete with an average score of 53, so that the classical completeness at the pre-test was 10%. In the post-test obtained as many as 47 students were declared complete and only 2 students were declared incomplete with an average score of 83, so that the classical completeness at post-test increased by 96%. This proves that the completeness of learning outcomes increases significantly and classical completeness> 85% of the total number of students, so it can be said that the classical completeness of learning with the Science Integrated Learning (SIL) model has been achieved.

Improving student learning outcomes after the implementation of learning with the Science Integrated Learning (SIL) model shows that the stages in learning are able to help students construct the concepts so that they can increase the accommodation capacity of the concept. The high score of improving learning outcomes and completeness of individuals and classics is supported by excellent student responses to Science Integrated Learning (SIL) based learning. In line with the research of Wulandari, et al. (2013) which states that learning with a guided inquiry model can have a positive influence on students' academic success and can improve critical thinking skills. Whether or not a student's response to learning remains a very meaningful input for improving the quality of learning.

Table 3 shows the results of the pre-test and post-test analyzed using Normalized Gain (N-Gain). The N-Gain results showed that almost all students who experienced to increase the critical thinking skills after learning through the Science Integrated Learning (SIL) model, is as many as 2 students in the low category, 32 students in the moderate category and 15 students in the high category. The improvement is shown by the N-Gain calculation shows that science learning with the Science Integrated Learning (SIL) model is effective in improving students' critical thinking skills in *perpindahan kalor* material. Students' critical thinking skills can improve well if the teacher is

able to create a comfortable learning environment that allows students to interact and discuss each other (Basri, 2015).

The post-test results on each indicator of critical thinking indicate that the indicators determine such ways that can be used to deal with the problem and the indicators analyze the data at 0.86 and 0.72, so that it is categorized as high. On indicators recognize problems, collect and compile information and indicators to draw conclusions and similarities needed for each of 0.60 and 0.32 so that it is categorized as moderate.

The test results of students' scientific independence skills as a manifestation of HOTs (Parmin et al., 20017). This increase is in accordance with Vgotstsky's theory that students can learn concepts well if they are in the promiscuous improvement zone (zone of promax), that is, students can solve problems after getting help from others. N-gain acquisition shows that learning improveed with the Science Integrated Learning (SIL) model is effective in training students' critical thinking skills. This is in accordance with Arends's theory, 2012 that an increase in students' critical thinking skills is achieved because the selection of the right learning model so as to support the learning process to achieve goals.

Science Integrated Learning (SIL) models at each stage are able to insert aspects of critical thinking and give more meaning in learning so that they can provide high quality learning in critical thinking aspects. The stages of the *Science Integrated Learning* (SIL) model are able to create a learning atmosphere that is oriented towards exploring students' ideas. Exploration of student ideas will construct their understanding of a concept, so that the important aspects of learning will be mastered by students. *Science Integrated Learning* (SIL) is a change that aims to emphasize the most important aspects of learning.

V. CONCLUSION

Based on the findings of the research, it can be concluded that the *Science Integrated Learning* (SIL) model improveed effectively to improve students' critical thinking skills.

SUGGESTIONS

- In general, researchers have succeeded in improveing learning that can improve the critical thinking skills of fifth grade elementary school students in heat material, so that the educators are expected to use it so that classroom teaching learning is more effective.
- For the use of the *Science Integrated Learning* (SIL) learning model, time management and number of students needs to be considered especially for classes or students who have never implemented the *Science Integrated Learning* (SIL) learning model.
- Learning science with the *Science Integrated Learning* (SIL) model that has been carried out in this study has been effective to improve students' critical thinking skills in *perpindahan Kalor* material, so that the further research can be analyzed it in other basic competencies.

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