Research Article

Critical Thinking Skills Enhancement: Implementation of CLIS Learning Models on Work and Energy

Erwina Oktavianty[1]*, Haratua Tiur Maria Silitonga[1], Reni Marlina[2], Irwan Muhammad Ridwan[3], Indah Sanita Dirsa[4]

[1]Department of Physics Education, Universitas Tanjungpura Jl. Prof. Dr. Hadari Nawawi, Pontianak, Indonesia
[2]Department of Biology Education, Universitas Tanjungpura Jl. Prof. Dr. Hadari Nawawi, Pontianak, Indonesia
[3]Department of Physics Education, Universitas Siliwangi Jl Siliwangi No. 24, Tasikmalaya 46115, Indonesia
[4]SMP Negeri 6 Sambas, Jln. Sambas, Sambas, Indonesia

ORCID
Erwina Oktavianty: https://orcid.org/0000-0002-2159-3701
Haratua Tiur Maria Silitonga: https://orcid.org/0000-0003-3979-4947
Reni Marlina: https://orcid.org/0000-0003-0629-5113
Irwan Muhammad Ridwan: https://orcid.org/0000-0002-5498-5437

Corresponding Author: Erwina Oktavianty; email: erwina.oktavianty@fkip.untan.ac.id

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Abstract.
This study aimed to improve critical thinking skills (CTs) using the children learning in science (CLIS) model of students about work and energy at Junior Secondary School. The form of research used a pre-experiment with a one-group pretest-posttest design. The research participants were 28 students (eight grades) selected by using the intact group technique, randomly. The research instrument consisted of 6 essay questions. The result showed CTs students on work and energy was 49% in the medium category before the CLIS Lesson, while in the posttest it was 63% with the high category. Statistic descriptive analysis shows t count > t table, which means that Ho is rejected. It reveals a significant increase in the CTs of students. The increase in CTs in the CLIS model uses a gain score of 0.3 in the moderate category. So, it can be concluded that applying the CLIS model can improve CTs in energy and work materials. The CLIS model can be used as an alternative in the learning process to improve student's CTs in work and energy materials.

Keywords: critical thinking skills, CLIS learning models, work and energy.

1. INTRODUCTION

Learning Natural Sciences emphasizes the learning process that applies 4C skills. One of them aims to develop students' competence in exploring and understanding nature naturally by providing a direct experience. Through science learning, students are expected to have skills in critical thinking so that student learning outcomes can experience an increase in learning outcomes [1].

Science learning skills that are expected to exist in students have experienced much development. One of the developments is in 21st-century learning. The development of 21st-century learning provides various skills for students focused on succeeding in doing manual things and more focused on communicating, working together, thinking critically in a problem, and being innovative and creative. According to the Indonesian Ministry of Education [2], competence in the realm of skills expected in students is shown in reasoning, processing, presenting effectively, creatively, productively, critically, independent, collaboratively, communicatively, and problem solver. The skill states that the 2013 curriculum learning is a response to 21st-century learning, wherein 21st-century learning there are skills, namely Communication, Collaboration, Critical Thinking, and Problem Solving, and Creativity and Innovation (4C), which in daily implementation are widely used rather than just mastery of complex skills.

Critical thinking skills are a process of thinking by giving reasons based on the available evidence, according to the situation and the concept in question. Someone who has excellent critical thinking ability has excellent curiosity, is current, has reliable reasoning, is open-minded, flexible, balanced in evaluating, honest in dealing with personal prejudices, careful in making decisions, willing to reconsider, transparent to issues, intelligent in seeking relevant information, reasoned in choosing criteria, focused in an investigation, and persistent in seeking findings. According to [3–5] critical thinking skills play an essential role in education and are the main goal in learning where; there are six aspects of critical thinking, including interpretation, analysis, inference, evaluation, explanation, and self-regulation.

Critical thinking is very closely related to the cognitive aspect; this is shown from the TIMSS and PISA surveys, where the questions' characteristics require critical thinking skills. Contextual questions require reasoning, argumentation, and creativity in solving them [4]. Therefore, in Indonesia, the UN questions in the 2018/2019 academic year have implemented HOT-based questions, one of the abilities on the HOTs questions, namely critical thinking. The opposite happened at SMP Negeri 6 Sambas. According to the teacher's narrative, students' critical thinking skills were still in the low category; this was evident in the results of the daily tests and semester tests that had been carried out last year by the teacher. In addition, most of the physics learning process is carried out using one-way learning, emphasizing the delivery of learning materials (conventional methods). In this method, the active involvement of students in the learning process is still lacking.

The weakness in using conventional learning methods is learning that is too mathematical. Students tend to be required to memorize and use these formulas without understanding the concepts behind their formation, so that they find it challenging to absorb the physical concepts. Notably, this study's work and energy material are based on the 2013 curriculum on essential competencies, namely explaining the concept of work, simple machines, and their application in everyday life, including muscle work on the human skeletal structure. The students should connect one concept work to another concept in physics and give argumentation that is relevant to the work and energy problems. This has an impact on the low results of mastery of physics concepts achieved by students. As shown by the average daily test scores for the previous material. In addition, conventional learning cannot grow students' critical thinking skills because learning is focused on cognitive aspects, while psychomotor and affective aspects are not paid attention. Conventional methods cause the opportunity for students to be involved in the learning process and the opportunity [6] one of the lessons that are seen as being able to help and facilitate to facilitate students in mastering physics, practicing developing critical thinking skills and mastering concepts is the Children Learning In Science (CLIS) model. This learning model creates an environment that supports a critical thinking framework through practical learning activities involving students' activeness in observing and experimenting with activities using the Student Discussion Sheet (LDPD). This is supported by research [7–9] which shows that the CLIS model can improve critical thinking skills in physics learning.

The CLIS model is based on a constructivist view. In constructivism, learning appreciates the role of critical experience in the process and naturally encourages curiosity in students. They were learning assessment places more emphasis on the performance and understanding of students and bases the learning process on the principles of cognitive theory. The students must build their knowledge through prior knowledge and experience [10]. This method provides opportunities for students to find, do, and be active in the learning process, observe or listen to exciting things. Thus, it provides better results in terms of science education [11]. Therefore, the experimental method contained the implementation of the CLIS model applied in science learning. This study has aimed to improve students' critical thinking skills through the CLIS learning model at work and energy discussion.

2. RESEARCH METHOD

The form of research used a pre-experimental method with a one-group pretest-posttest design [12]. This design observed the impact of the CLIS Learning model on the critical thinking skills of students. Observations were made before the experiment as a pretest

(O1) and posttest (O2) after the treatment. The difference between O1 and O2 is that O2-O1 is assumed to be the effect of treatment.

Sample in the study determined through the intact group. An intact group is a technique to find a complete population sample by showing the class choices. One class was randomly selected from several existing classes to be included in this study, namely VIII A, with a sample of 28 students at SMPN 6 Sambas. CLIS learning model was implemented as independent variables as the method of lecture. Moreover, the dependent variable is critical thinking skills that have three aspects of critical thinking, namely interpretation, analysis, and explanation. Each aspect has two indicators: describing meaning, clarifying intent, examining ideas, identifying arguments, stating results, and presenting arguments. Six essay questions are used to fulfill the aspects, where one essay question represents an indicator of critical thinking. Data were analyzed by statistical descriptive that informs the significance of the students' critical thinking skills improvement.

3. RESULTS AND DISCUSSION

3.1. Critical Thinking Skills Before and After Applying the CLIS Model

The following show at Table 1, the result as a percentage of students' critical thinking skills scores on the work and energy material can be seen from the increase in the total pretest and posttest scores.

TABLE 1: Recapitulation of pretest-posttest score of students's critical thinking skills.

Aspect	**Pretest**		**posttest**	
	Score	**Mean**	**Score**	**Mean**
Interpretation	128	4.57	139	4.97
Analysis	100	3.57	121	4.33
Explanation	99	3.54	165	5.89
Total	327	11.68	425	15.19
Max	672	24	672	24
%	49%		63 %	
Category	Medium		High	

3.2. Aspect of Critical Thinking Skills (CTs)

The data on the percentage of students' critical thinking skills for each aspect can be seen in Figure 1 Recapitulation of the results of the pretest and posttest achievements of students' critical thinking skills.

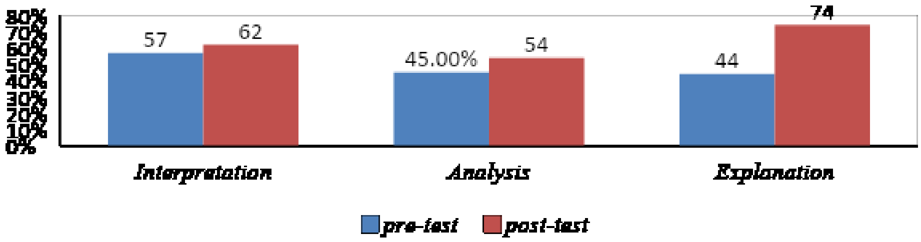

Figure 1: Students' critical thinking skills in each aspect.

Based on the graph above, it is known that the lowest score percentage for the critical thinking skills aspect of students at pretest is in the explanation aspect at 44%, and the highest score percentage in the interpretation aspect is 57%. The lowest posttest score (in percentage) is in the analytical aspect, which is 54%, and the highest percentage score is in the explanation aspect, which is 74%. By comparing the percentage acquisition of each aspect of students' critical thinking skills (CTs), it was found that the pretest score was lower than the posttest.

Each aspect of CTs has two indicators of critical thinking skills. These indicators also indicate the subject matter discussion which each indicator represents one question of works and energy. The percentage of students' critical thinking skills scores for each CTs's indicator can be seen in Figure 2. Recapitulation of the pretest and posttest results of the students' critical thinking skills indicator achievement.

Information:

Indicator 1=Categorizing Indicator 4=Identifying Arguments

Indicator 2= Classifying Indicator 5= Declaring Results

Indicator 3= Examining Ideas Indicator 6 = Presenting Arguments

Based on Figure 2, by comparing the average score of each aspect of students' critical thinking skills, it was found that each posttest score was higher than the pretest. Each aspect of critical thinking skills (CTs) has two indicators. Indicator categorizing and classifying has come from the interpretation aspect of CTs. The chart is shown a slight difference between pretest and postest percentages. However, in the second aspect, the analysis aspect with two indicators (examining ideas and identifying arguments), has the lowest percentage of critical thinking skills improvement, respectively 8% and 11 %.

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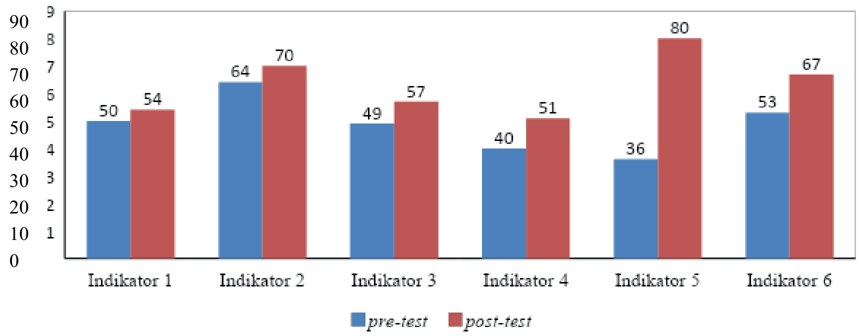

Information:

Indicator 1=Categorizing **Indicator 4=Identifying Arguments**

Indicator 2= Classifying **Indicator 5= Declaring Results**

Indicator 3= Examining Ideas **Indicator 6 = Presenting Arguments**

Figure 2: Students' critical thinking skills on each indicator.

These indicators asked the notion of potential energy and the factors that affect potential energy, and the relationship between potential energy and effort. The last aspect in this study is revealed in the two last indicators (declaring results and presenting arguments). Indicator 5, which discusses the concepts of kinetic energy, potential energy, and mechanical energy, has 36% in the pretest while in the posttest 80%. Indicator 6 is represented by question number 6, which discusses the effect of gravity on business with a pretest percentage of 53%, and after experiencing learning the posttest, the percentage increased to 67%.

Based on the results of the pretest, aspects of interpretation, analysis, and explanation were observed. The aspect that has the lowest score is the explanation aspect. This aspect consists of 2 indicators; each indicator is found in question 5 with the indicator "stating the results" and question number 6 with the indicator "presenting arguments." In question number 5, students are expected to state the energy at each point of information on an event and provide an appropriate equation with the essential concept. It can be seen in one of the students' answers in Figure 3.

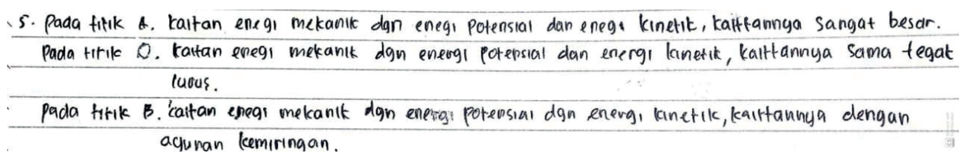

Figure 3: Students' answers to indicator 5 pretest.

From the snippet of the students' pretest answers above, it can be seen that students are still unable to understand and compare the concepts contained in kinetic energy, potential energy, and mechanical energy. This is relevant to research which states that most students are less able to express their opinion according to the right concept.

After being given learning and filling out the posttest sheet, the result of this indicator five increased by 0.7, which was categorized as high among other indicators. And in the explanation aspect, it also experienced the highest increase, which was 0.5 in the medium category, as shown in Figure 4.

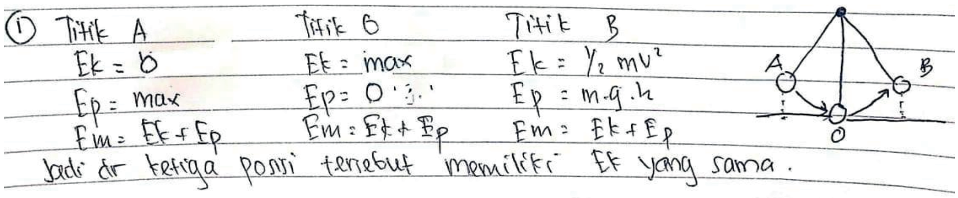

Figure 4: Students' answers on indicator 5 posttest.

It can be seen from the results of the students' post-test answers. On average, students can compare kinetic energy, potential energy, and mechanical energy, which is expressed by the formula found at each point, that is, when the child is riding the swing. Critical thinking indicators, in a particular state the results of most students being able to state the results of the information needed from the problems given so that the results of this indicator are pretty high. Students after experiencing learning, critical thinking skills, especially indicators of presenting arguments, have increased, which can be seen from the ability of students to accept or reject information supported by arguments, data. The facts satisfy objections (rebuttals) to the methods, concepts, evidence, and logical criteria given. In addition, it was also caused the material that the students had not mastered after the CLIS learning was carried out, which emphasized the alignment of the right concepts [13], the process of science in learning can provide students with the experience to think critically. Students can answer this question well.

3.3. Improving Students' Critical Thinking Skill

The data of the students' pre-test and post-test scores then calculated the gain value to calculate the students' increase in critical thinking skills. Before calculating the gain value, it is necessary to do a prerequisite test, namely the normality test. The test aims to determine whether the data is normally distributed or not. The resulting data is normally distributed, then proceed with the parametric statistical test, namely the t-test. To find out the significant increase in students' critical thinking skills after the CLIS model is applied, a statistical prerequisite test is needed, namely the normality test (Lilliefors test), to determine whether the data is normally distributed or not. The resulting data are normally distributed, then proceed with parametric statistical tests, namely the t-test. The test criteria are if $L_{count} < L_{table}$ then the data is normally distributed and if $L_{count} > L_{table}$ then the data is not normally distributed seen in the table 2.

TABLE 2: Pretest and posttest data normality test recapitulation.

Data	Pretest	Posttest	Conclusion
N	28	28	$L_{count} < L_{table}$ then the data is normally distributed.
L_{count}	0.0997	0.103	
L_{table}	0.17051	0.17051	

Because the data is normally distributed, it is continued by testing the hypothesis (t test). The result is seen in the table 3 below.

TABLE 3: The result of hypothesis test (t-test).

Data	T test	
	Pretest	Posttest
Means	11.678	15.18
T_{count}	7.978	
t_{table}	2.0518	
Conclusion	$T_{count} > t_{table}$ then this proves that H0 is rejected, there is a significant difference	

Based on the table, it is known that t_{count} obtained is 7.978 and t_{table} is 2.0518. With hypothesis testing criteria: If $t_{count} < t_{table}$, then Ho is accepted. The data in table $t_{count} > t_{table}$ (7.978 > 2.0518) proves that H_0 is rejected. This means a significant increase in students' critical thinking skills after the CLIS model is applied to learning. This is in accordance with the research of [14]. The essential factor in implementing the CLIS model that needs to be considered is creating an open learning situation and giving students the freedom to express ideas or ideas, allowing students to ask questions freely with friends or teachers. One of the advantages of CLIS learning is that learning could be created to be more meaningful in condition and solving problems, particularly in science concept attainment [15, 16]. Thus, it helps students to improve critical thinking skills.

4. CONCLUSION

From the discussion above, it can be concluded that the application of the Children's Learning In Science (CLIS) model can improve students' critical thinking skills about work and energy for class VIII SMP Negeri 6 Sambas. The percentage of students' critical thinking ability on each indicator at works and energy material was 49% in the medium category (pretest), while at the posttest, the percentage was 63 % with high category. The student's critical thinking skills improvement at work and energy material taught using the CLIS model at SMP Negeri 6 Sambas was significant (t_{count} (7.978) > t_{table} (2.0518)) then H0 is rejected after the CLIS model is applied with an increase.

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