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ICARE-U Learning Model to Improve Critical Thinking Skills of High School Students in Indonesia

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Abstract: Critical thinking is one of the skills that are widely trained in the field of natural science studies. The study was conducted at a high school in the city of Padang to determine the effectiveness of ICARE-U learning (Introduction, Connection, Application, Reflection, Extension and Utility) on students' critical thinking skills in the matter of effort and energy. The research method used is pre-experimental with one group pretest posttest design. The research sample consisted of one class 10 high school as many as 31 people. Critical thinking skills are viewed from 5 aspects, namely elementary clarification, basic support, inference, advanced clarification, strategy and tactics. Based on the results of the n-gain on students' critical thinking skills with the ICARE-U learning model, a score of 0.4 was obtained. A score of 0.4 means that students' critical thinking skills before and after being given treatment have increased in the moderate category. Reviewing the critical thinking skills aspect, it is known that the advanced clarification aspect is still experiencing a low increase. Based on the results of hypothesis testing, it was found that the ICARE-U learning model was effectively used to improve students' critical thinking skills in the matter of effort and energy.

Keywords: Critical thinking skils, ICARE-U learning model, work and energy.

Abstrak: *Berpikir kritis merupakan salah satu keterampilan yang banyak dilatihkan untuk bidang studi ilmu pengetahuan alam. Penelitian dilakukan pada sebuah SMA di kota Padang untuk menentukan efektivitas dari pembelajaran ICARE-U (Introduction, Connection, Application, Reflection, Extensiom dan Utility) pada keterampilan berpikir kritis siswa dalam materi usaha dan energi. Metode penelitian yang digunakan adalah pre-eksperimental dengan desain one group pretest postest. Sampel penelitian terdiri dari satu kelas 10 Sekolah Menengah Atas sebanyak 31 orang. Keterampilan berpikir kritis ditinjau dari 5 aspek yaitu elementary clarification, basic support, inference, advanced clarification, strategy and tactics. Berdasarkan hasil n-gain terhadap keterampilan berpikir kritis siswa dengan model pembelajaran ICARE-U didapatkan skor 0,4. Skor 0,4 memiliki arti bahwa keterampilan berpikir kritis siswa sebelum dan sesudah diberi perlakuan mengalami peningkatan dengan kategori sedang. Peninjauan terhadap aspek keterampilan berpikir kritis diketahui bahwa pada aspek advanced clarification masih mengalami peningkatan yang rendah. Berdasarkan hasil pengujian hipotesis didapatkan bahwa model pembelajaran ICARE-U efektif digunakan untuk meningkatkan keterampilan berpikir kritis siswa dalam materi usaha dan energi.*

Kata kunci: *keterampilan berpikir kritis, model pembelajaran ICARE-U, usaha dan energi.*

▪ INTRODUCTION

Critical thinking is the ability to generate ideas, analyze, apply, interpret, organize proposed ideas to make decisions and draw conclusions about facts and phenomena in the environment (Aslan & Aybek, 2020; Fazriyah, 2017; Syawaludin, Gunarhadi, & Rintayati, 2019). Critical thinking needs to be developed and taught because it can improve education in learning (Pulungan, Sirait, & Ginting, 2021; Tincu, 2001; Trilling & Fadel, 2009). In line with this critical thinking skills are very important to become

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students because they are sone of the skills that are central to the future development of the world community (Redhana, 2013) and are important for someone to have to enter the industrial world as it is today (Nuryanti, Masykuri, & Susilowati, 2018). However, many studies in the field of education in Indonesia show that students' critical thinking skills are still relatively low (Bhakti et al., 2019; Mahbubah, Habibulloh, Hermita, & Samsudin, 2020; Ningsih et al., 2019; Nisa, Nafiah, & Wilujeng, 2020).

Previous research revealed that learning in some schools has not been able to optimally train students' critical thinking skills. Research at high schools in Bandung showed that students' critical thinking skills were still low (Wayudi, Suwatno, & Santoso, 2020) and there were still many students who were categorized as weak in critical thinking (Fasha, Johar, & Ikhsan, 2018)f. This is due to the lack of encouragement in students to develop their thinking abilities, learning tends to be limited to theory which is lacking in terms of its application. Furthermore, the causes of the weak critical thinking skills of students include the lack of experience of students in critical thinking during learning so that it is difficult for students to increase their abilities to a higher level of thinking, students' motivation to carry out critical thinking activities is still low, and physical factors that are less stable. causes students to concentrate less in making decisions on a problem (Wayudi, Suwatno, & Santoso, 2020).

Based on a preliminary study conducted on students' critical thinking skills in one of the senior high schools in Padang City, it was found that students' critical thinking skills were still low. This is evident from the fact that many students still have misconceptions and do not understand the concept of physics compared to understanding the concept. Furthermore, based on the results of interviews with teachers, it was found that students' critical thinking skills were still poorly trained because learning so far has only been carried out with a teacher center.

Critical thinking skills are important for students to be able to increase the success of students in learning (Wayudi, Suwatno, & Santoso, 2020; Susilawati, Agustinasari, Samsudin, & Siahaan, 2020). Therefore, to be able to improve student learning outcomes, learning strategies are needed that can help students practice their critical thinking skills. In addition, strategies in learning can also help students increase their speed in absorbing the material being studied (Wingert et al., 2011). Learning strategies can be realized through the use of appropriate learning models.

Based on several studies, critical thinking skills can be improved through the application of the inquiry learning model to high school students in Mataram in the experimental class compared to the control class (Ilhamdi, Novita, & Rosyidah, 2020). Other studies have shown that problem based learning models can develop critical thinking skills (Mahmuzah, 2015). Judging from the media and teaching materials used, the use of teaching materials and student worksheets in STEM learning activities is also able to improve students' critical thinking skills (Lestari, Astuti, & Darsono, 2018). In addition, the ICARE learning model is also able to improve students' critical thinking skills (Muharti, 2016; Sa'Diyah et al., 2021)

The ICARE learning model has 5 stages, namely Introduction, Connection, Application, Reflection and Extension. The ICARE learning model that is applied is the development of one using the help of Multimedia Based Integrated Instruction (MBI2) (Pratiwi et al., 2020). Through multimedia assistance in the ICARE learning model, it

can improve students' critical thinking skills. Further development of the ICARE learning model is the use of physics material in life which makes ICARE become ICARE-U, namely U as Utility. The use of physics material in everyday life is expected to make physics material more interested in physics and can train students' critical thinking skills. The addition of utility to the ICARE-U learning model is intended to achieve learning objectives as in line with the previous ICARE learning model (Dwijayani, 2018). The following are the steps for learning the ICARE-U model which are implemented for students:

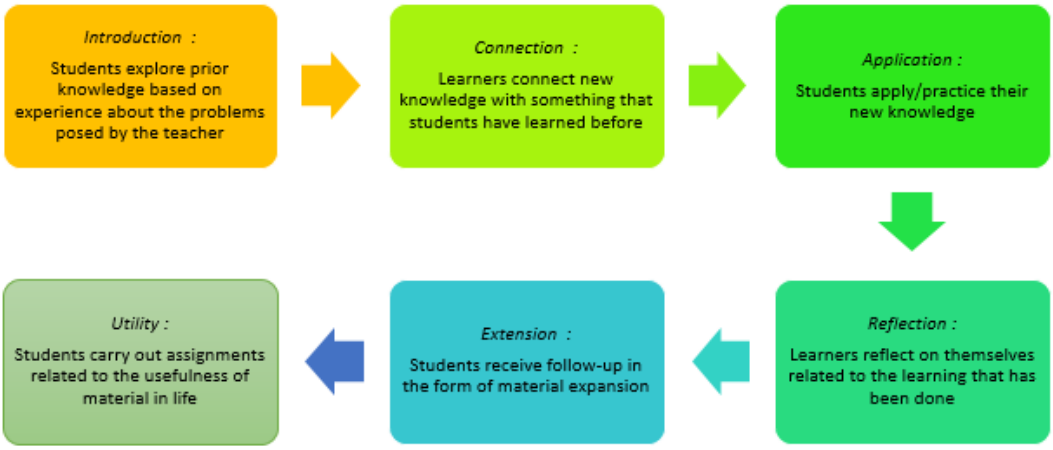

Figure 1. Stages of learning model icare-u

▪ METHOD

Participant

The participants were all high school students who had not studied the business and energy materials, which were 31 students of class X SMA in Padang. Participants consisted of 11 men and 20 women. Sampling of participants using purposive sampling so that the sample comes from a homogeneous and representative class.

Research design and Procedures

The research method used is a quantitative method with a pre-experimental design. This method is used because it does not control the variables that influence and control variables (prof. dr. sugiyono, 2011). In addition, this method was chosen because the sample class was not chosen at random but was chosen with a specific purpose. The research design used was one group pretest posttest. The study began with giving pretest to students followed by giving treatment in the form of the ICARE-U learning model in learning and ended with giving posttest to students. Data analysis of pretest and posttest scores was given to students through N-Gain.

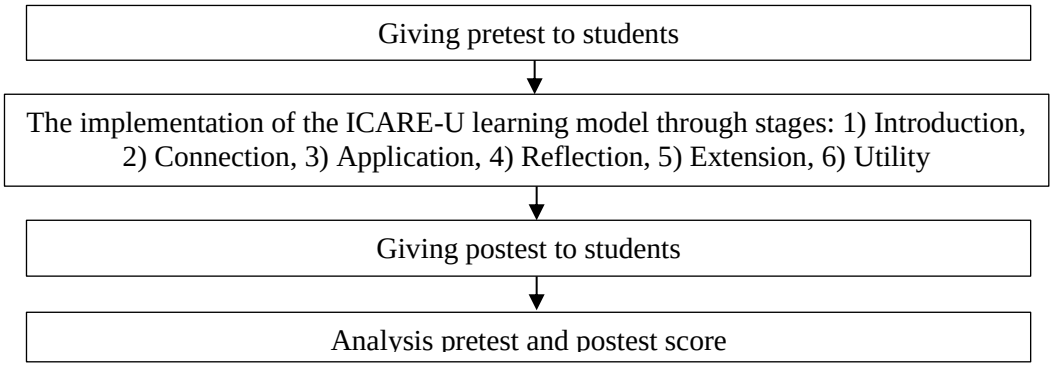

Figure 2. Stages of research design

Instrument

The research instrument used was multiple choice test questions totaling 20 questions with five answer choices. The test items before being used in the study were tested for validity, reliability, discriminatory power and level of difficulty of the questions. Based on the results of the analysis of the test items, the research instrument was valid and reliable with revisions to several question numbers. The critical thinking skills test item instrument used refers to aspects of critical thinking skills (Ennis, 1985) which consist of five main aspects, namely elementary clarification, basic support, inference, advance clarification, and strategy and tactics.

In the research instrument used, in the aspect of elementary clarification, students are required to have skills in analyzing questions that arise from a given physical event / phenomenon. Various possible answers that can be given by students in this aspect. In fact, not infrequently the questions that arise are not in accordance with the context of physics given to the problem. In addition, in this aspect, an analysis of the simple statements raised relating to physics material is also carried out. Students must choose the right analysis of statements related to the physics material that is raised. In the basic support aspect, students assess/consider the correct information realized through the types of questions about the ability of students to choose the right statement related to the physics problem that is raised. The inference aspect is related to the ability of students in terms of their ability to draw conclusions related to physics events. In the aspect of advance clarification, students are able to provide estimates based on the assumptions given. In the aspect of strategy and tactics students are able to provide actions in the form of arguments related to physics problems which are a form of strategy given by students. Aspects and indicators of critical thinking skills studied can be seen in table 1 below:

Table 1. Aspects and indicators of critical thinking skills

No.	Aspects of critical thinking skills	Indicators of critical thinking skills	Question indicator	Question number
1	Elementary clarification	Focusing the question	Identify the most appropriate questions related to physics quantities	No. 1-6
2	Basic support	Assess/consider correct information	Assess the correct statement	No. 7 -10

3	Inference	Summarizing the results of induction	Summing up an event to solve a problem	No. 11-14
4	Advanced clarification	Giving assumptions	Provide assumptions regarding problem solving solutions	No. 15-17
5	Strategy and tactics	Determine the action / strategy	Giving action in the form of arguments related to physics problems	No. 18-20

The following is an example of one of the critical thinking skills test items used in the study:

Aspects of critical thinking skills: Advanced clarification
Indicators of critical thinking skills : Giving assumptions
Question :
In weightlifting, when a person is in a full squat condition and lifting weights, the weight can be lifted by a distance of 0.43 meters. If the same person lifts weights from the half-squat phase, he will cover a total distance of 0.215 meters. Assuming all other variables are the same, a person in a full squat means twice as much effort as a half squat. What must a half-squat do to have the same effort as a full-squat person?

A. to reduce work by half
B. to reduce work by 2 times
C. increase work by half
D. enlarge work 2 times again
E. enlarge work 4 times again

Figure 3. Examples of critical thinking questions

Data Analysis

The improvement of students' critical thinking skills was measured using normalized n-gain analysis. The criteria for normalized n-gain <g> are high criteria if the value <g> 0.7, moderate criteria if 0.7 > <g> 0.3 and low criteria if <g> < 0.3. Furthermore, hypothesis testing is used to determine the effectiveness of the ICARE-U learning model on students' critical thinking skills, starting with the Shapiro Wilk normality test, followed by hypothesis testing with the help of the SPSS 26 application. The normality test criteria used are if the value of sig <0.05 then the data is not normally distributed and if the value of sig> 0.05 then the data is normally distributed and the hypothesis test criteria used is if the value of sig (2-tailed) <0.05 Hi accepted, namely the ICARE-U model has an influence on the results of critical thinking skills and if the value of sig (2-tailed) > 0.05 Ho is accepted, the ICARE-U model has no effect on the results of critical thinking skills.

▪ RESULT AND DISSCUSSION

The achievement of students' critical thinking skills begins with the stage of giving a pretest to students (as a reference to determine students' initial abilities) then

after being treated with the ICARE-U learning model, a posttest is given to students at the end of the lesson. Data analysis for students' critical thinking skills used normalized gain analysis (Hake, 1998). The normalized N-gain score <g> was obtained through the students' pretest and posttest scores with a maximum score of 100.

Table 2. Recapitulation of the results of the pretest and posttest of students' critical thinking skills with n normalized gain

Mean score		$< g >$ **Category**
Pretest	**Postest**	
35.8	66.4	0.48 (Medium)

The score n gain normalized critical thinking was obtained in the medium category, meaning that students' critical thinking skills before and after being given treatment experienced an increase in the category of improvement which was classified as moderate. This is in line with previous research (Husein, Herayanti, & Gunawan, 2017; Siahaan, Setiawan, Fratiwi, Samsudin, & Suhendi, 2020). Based on the aspect of critical thinking skills consisting of 5 indicators, each of which can be seen the value of the n-gain pretest posttest in the following table:

Table 3. Recapitulation of the n-gain of each aspect of critical thinking skills

No.	**Aspects of critical thinking skills**	**Mean**		$< g >$ **Category**
		pretest	**postest**	
1	Elementary clarification	8.2	18	0.45 (medium)
2	Basic support	4.6	13.5	0.57 (medium)
3	Inference	9.4	14.6	0.50 (medium)
4	Advanced clarification	10.3	11.2	0.20 (low)
5	Strategy and tactics	3.3	9.2	0.50 (medium)

The normalized n-gain category for most of the indicators of critical thinking skills has a moderate n-gain category, as well as the average n gain of critical thinking skills for all students in table 2 and table 3. It can be concluded that students' critical thinking skills are still in moderate category in each aspect of critical thinking skills except in the advanced clarification aspect. In this aspect, students' critical thinking skills are still low based on normalized n-gain results. This means that in the advanced clarification aspect, critical thinking skills are included in the category of low improvement. The advanced clarification aspect is an aspect of critical thinking skills where students are asked to provide further clarification on a problem, which can be in the form of giving assumptions in order to find solutions related to problem solving and being able to provide estimates of an assumption given from a problem. In addition, in this aspect, students are expected to be able to define the meaning/definition of related physics equations (Siahaan et al., 2020).

Furthermore, the n-gain score which is relatively low after advanced clarification is in the elementary clarification aspect. Based on table 3 at the elementary clarification stage, students get a low score of n gain. If at the basic stage of clarification, students have shown low scores, then at the advanced stage, namely advanced clarification, they will also show low scores. The critical thinking aspect of basic support has the highest score of n gain in this study but still has moderate criteria. This proves that students have increased with moderate criteria in terms of assessing correct information in choosing the right statement related to the physics problem that was raised. In line with this, the critical thinking aspects of inference and strategy and tactics have the same n gain score with the moderate criteria. This can be interpreted that students are able to draw conclusions related to physics events and are able to provide arguments related to the physics problems given.

Associated with hypothesis testing on the effectiveness of the ICARE-U model on students' critical thinking skills, it begins with a normality test. The normality test was carried out on the average value of the pretest and posttest scores obtained by students. The normality test used to analyze the number of samples in one class (31 students) was the Shapiro Wilk test.

Table 4. The results of the normality test of students' critical thinking skills

	Kolmogorov smirnov			**Shapiro-Wilk**		
	Statistic	**df**	**Sig.**	**Statistic**	**Df**	**Sig.**
Pretest	0.289	31	0.000	0.784	31	0.000
Postest	0.328	31	0.000	0.688	31	0.000

The criteria in the normality test are if the value of sig < 0.05 then the data is not normally distributed and if the value of sig > 0.05 then the data is normally distributed. From the results of the normality test and the results of the Shapiro Wilk test (data <50), the pretest and posttest sig. 0.000 <0.05, it was concluded that the data were not normally distributed. Then the hypothesis test was continued with the Wilcoxon test because the data obtained were not normally distributed (nonparametric statistics).

Then, the hypothesis was tested using the Wilcoxon test with the criteria that if the value of sig (2-tailed) <0.05 Hi was accepted, namely the ICARE-U model had an influence on the results of critical thinking skills and if the value of sig (2-tailed) > 0.05 Ho accepted that the ICARE-U model has no effect on the results of critical thinking skills.

Based on the results of the analysis of the hypothesis test carried out, the value of Assymp sig. (2 tailed) of 0.000 which indicates a value of <0.05, it can be interpreted that Hi is accepted, namely the ICARE-U model has an influence on the results of critical thinking skills. In this case, ICARE-U is effective in making students able to think critically about the learning materials provided.

▪ CONCLUSION

Based on the findings of the study, it can be concluded that the ICARE-U model is effective in improving critical thinking skills. This is evidenced by the results of increasing students' critical thinking skills with an n-gain score of 0.4 with a moderate improvement category. So, the ICARE-U learning model can be implemented in

training students' critical thinking skills in learning physics. The ICARE-U learning model has an impact in the form of increasing student skills in terms of knowing the use of physical material in life. Research that has been done regarding the ICARE-U learning model is still being applied to train students' critical thinking skills. Further research can be done to train other skills in the ICARE-U learning model.

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