Physics Learning through Active Learning Based Interactive Conceptual Instructions (ALBICI) to Improve Critical Thinking Ability

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Abstract

The process of physics learning in MAN (Islamic senior high school) 2 Bandar Lampung which is still teacher-centered causes students to have low critical thinking skills. One learning model that can be used to overcome this problem is the Active Learning Based Interactive Conceptual Instructions (ALBICI) model which is equipped with Predict, Discuss, Explain, Observe, Discuss, Explore, Explain Tasks (PDEODE*E tasks). The purpose of this study is to determine the effectiveness of the ALBICI model with PDEODE*E tasks in improving students' critical thinking skills on momentum and impulses subject material. The type of research used is quasi-experimental with 30 students of the class X_1 as the experimental class and 30 students of class X_2 as the control class. The results of data analysis using t-test at a significance level of 0.05 indicate that the ALBICI model with PDEODE*E tasks iseffective in improving students' critical thinking skills. Furthermore, theobtainedeffect size of 0.6 indicates that the model's effectiveness falls into the medium category.

Keywords: ALBICI Model, PDEODE*E Tasks, Critical Thinking Ability, Physics Learning

INTRODUCTION

The growing educational paradigm nowadays requires students to be qualified and have competitive competencies so that they can be utilized as a major investment of development in various sectors of life (Novriyani *et.al.*, 2014). National education aims to develop the students' potential to become human beings who are faithful, devoted to God the Almighty, noble, healthy, knowledgeable, capable, creative, independent, and a democratic and responsible citizen (Lestari *et.al.*, 2016). Along with these objectives, the curriculum developed must be in accordance with the 21st-century learning paradigm that emphasizes students to have thinking and learning skills (Nugroho & Kulsum, 2014).

Learning in the world of education is inseparable from science learning. In learning science, especially physics, students are required not only to learn facts, laws, principles, and theories, but students are also required to experience how the process of facts and principles is obtained, so that learning is not only teacher-centered, but the students could actively build their own knowledge, discover, and develop their own facts and concepts through a series of scientific methods (Lia & Derlina, 2016). Knowledge building it can train students' thinking skills (Diani *et.al.*, 2018). Commonly, the physics learning activities carried out could make students feel difficult in the learning process, such as the teacher who is often using mathematical representations so that the students assume that the formulas and concepts must be memorized.

PISA conducted future-oriented assessments by testing the students' ability to use science skills and knowledge in the context of everyday life. The results show that students in Indonesia have not been able to skillfully utilize science knowledge in dealing with everyday life problems (Nisa' *et.al.*, 2015; Lestari & Muslim, 2016; Paramita *et.al.*, 2016; Wulandari & Sholihin, 2016). Physics is one of the subjects of science that is considered difficult to study and often causesthe students to complain. This is what makes them less motivated to take physics lessons (Minan, 2016).

The factors that influence the success of the learning process are thinking. This is based on learning objectives as a learning process that is improving thinking skills (Siswanto *et al.*, 2016; Hasan *et al.*, 2018). Bergun Bono defines thinking as an exploration of experience carried out consciously in achieving goals (Sari & Putra, 2015). The effort to form an optimal critical thinking ability requires an interactive class, students are seen as thinkers, not taught,

and the teacher acts as a mediator, facilitator, and motivator who helps students in learning rather than teaching (Irwandani & Rofiah, 2015; Karim & Normaya, 2015). Based on the statement, it is known that a person's critical thinking skills can be trained (Irnin, 2016).

The right learning model needs to be applied so that it can be a way for students to improve their critical thinking skills (Ningsih *et.al.,* 2012). In addition, good interaction between teachers and students can also improve critical thinking skills. The learning model also regulates the interaction between teachers and students, so that the selection of a good learning model is very much needed (Nugroho & Kulsum, 2014; Sunaryo, 2014).

There are many learning models that are suitable to be applied in physics learning (Matsun *et.al.,* 2016). One of the most popular is Problem Based Instruction (PBI) (Irnin, 2016). Because Problem Based Instruction is a learning model that can stimulate and optimize student thinking activities (Diani, 2015). Unlike the previous studies, this study utilized a new learning model, namely the ALBICI learning model with PDEODE*E tasks. The ALBICI learning model with PDEODE*E Tasks is intended to improve students' critical thinking skills by training students to play an active role in the learning process. The ALBICI learning model with PDEODE*E Tasks applied to momentum and impulse learning material can improve students' critical thinking skills through activities that apply momentum and impulses learning the material to students in daily life. This learning model is expected to improve students' critical thinking skills.

Research on the use of the ALBICI model with PDEODE*E tasks in learning physics has not been done much. The research that has been done is the effectiveness of the ALBICI model on understanding the concept of electric fields (Samsudin *et.al.,* 2016). This study aims to determine the effectiveness of physics learning with the ALBICI model on students' critical thinking abilities in impulses and momentum material.

METHOD

This study used quasi-experimental design, the subjects in this study were students in the X semester of MAN 2 Bandar Lampung, the population in this study was 131 students consisting of four classes; namely X MIA 1, X MIA 2, X MIA 3, and X MIA 4. In this study, the sample was the X MIA 1 class which consisted of 30 students as the experimental class and X MIA 2 which consisted of 30 students as the control class. The learning models used in the control class is direct instruction and in

the experimental class the ALIBICI learning model with PDEODE*E Tasks. The sampling technique used was cluster sampling, the independent variables in this study was the ALIBICI learning model with PDEODE*E Tasks and the dependent variable was the ability to think critically. The research design carried out in this study was the non-equivalent control group design.

Data acquired in this study was the data of students' critical thinking skills with initial data in the form of scores obtained through pretest and final data in the form of scores obtained through posttest.

The instrument used to assess students' critical thinking was a test. The tests were constructed by analyzing core competencies and competencies then analyzing critical thinking indicators that were used as a specification and then developed into critical thinking questions.

The method of data collection was in the form of description and observation tests. The try-out of the instrument was done using content validation. Then the tests' validity was checked using product moment. The reliability was checked using the Alpha formula, the level of difficulty of the problem is measured and tested for differentiation index.

The next instrument used was the observation sheet. The observation sheet data was measured using a Likert scale to assess the implementation of the ALIBICI model with PDEODE*E Tasks can be seen on Tabel 1.

Table 1. Scale Likert

Score	Description
5	Very Good
4	Good
3	Medium
2	Bad
1	Very bad

N_{Gain}test was used to find out the improvement of students' critical thinking skills. The improvement of students' critical thinking was seen by using the N_{Gain} equation as follows:

$$\text{N} - \text{Gain} = \frac{\text{posttest score} - \text{pretest score}}{\text{maximum score} - \text{pretest score}} \quad (1)$$

There are three categories of normalized N_{Gain} as presented in table 2.

Table 2. N_{Gain} Classification

N_{Gain} Value	Classification
$0.70 < N_{Gain} \leq 1.00$	High
$0.30 < N_{Gain} \leq 0.70$	Moderate
$N_{Gain} \leq 0.30$	Low

The results of the observations were analyzed by the formula 2:

$$\text{Score} = \frac{\text{score}}{\text{maximum score}} \times 100\% \quad (2)$$

RESULTS AND DISCUSSION

N_{gain} test was performed to see an increase in critical thinking skills after learning. The significantly increased results of the N_{Gain} test are presented at table 3.

1. Normality Test

The result of the normality test is presented at table 4, with the

conclusion that the data were normally distributed.

2. Homogeneity

The homogeneity test compares two largest and smallest variances. The result of the homogeneity test with a level of 0.05 was L_{table}>Lobserved. The homogeneity test of prettest obtained $F_{table}$of 0.169 and $F_{observed}$of 0.55. The homogeneity test of posttest obtained $F_{table}$of 0.161 and $F_{observed}$ of 0.20. This means that the data was homogeneous.

3. Hypothetical Test or t-Test

Testing of the hypothesis in this study was performed using the t-test of two uncorrelated samples. Hypothesis testing was done to test whether or not the application of the learning model used in learning activities influence the students' critical thinking skills. The results can be seen at table 5.

Table 3. N-gain of Experimental Class and Control Class

Class	N	Posttest Average	Pretest Average	N_{Gain}	Classification
Experimental	30	69.5	36.8	0.53	Moderate
Control	30	49.5	36.1	0.20	Low

Table 4. Results of Normality Test of Pretest and Posttest

Class	Pretest			Posttest		
	$L_{observed}$	L_{table}	Result	$L_{observed}$	L_{Table}	Result
Experimental	0.074	0.161	H_O is accepted	0.11	0.161	H_O is accepted
Control	0.071	0.161	H_O is accepted	0.11	0.161	H_O is accepted

Table 5. Summary of Hypothetical Test and Effect Size

Class	Samples	Hypothetical Test			Effect Size		
		$T_{observed}$ (0,05)	T_{table} (0,05)	Result	Average	Effect Size	Description
Experimental	30	8.434	2.001	H_0 is Rejected	69.5	0.6	Moderate
Control	30				49.5		

Effect size can be considered as the measurement of the level of researchers' success. (Ningsih, *et.al.*, 2012; Saregar, *et.al.*, 2017) with the formula 3:

$$d = \frac{m_A - m_B}{[(sd_A^2 + sd_B^2)/2]^{1/2}} \qquad (3)$$

The effect size is presented in Table 5. After the calculation was performed, the result of the effect size was 0.6 which is in the medium category based on thecriteria of effect size presented in table 7. It can be concluded that the treatment of physics learning using the ALBICI model with PDEODE*E Tasks given in the experimental class can improve

students' critical thinking skills in the impulses and momentum learning material.

Table 7. Criteria for Effect Size

Interval	Criteria
0< d < 0,2	Low
0,2< d < 0,8	Moderate
d>0,8	High

The improvement of students' critical-thinking ability due to the ALBICI model with PDEODE * E Tasks has four phases starting from 1) Conceptual focus 2) Use of texts 3) Research-based materials (PDEODE * E tasks) and 4) Classroom interactions (Samsudin *et.al.*, 2016). Learning requires students to be active in learning. With active learning, the learning objectives are more easily achieved and learning becomes more effective (Raehang, 2014; Dirgahayuning, 2017; Dzulfikri & Joko, 2013; Kurniawan & Arief, 2015; Kustijono, 2011). Learning models that involve the students and their whole potential during learning activities can improve students' critical thinking abilities (Syarifah & Yosaphat, 2015). Critical-thinking abilities can be trained through physics learning with learner-centered learning (Rahayuni, 2016).

PDEODE*E tasks in research activities also influence students' critical thinking abilities. Starting from predicting the problems given and providing an explanation that underlies the hypothesis made (Dipalaya *et.al.*, 2016). The students work in small groups to discuss the hypotheses made regarding the problems that will besolved. Furthermore, teachers and students in each group could improve and clarify understanding through discussion. Before making an observation, the teacher provides information to students about what will be observed and how to make an observation. The teacher and students observe something relevant. This raises questions for students about what they see, what will happen, and why it can happen. Students answer these questions by exploring knowledge by deduction. After making observation and demonstration, the students prove the hypotheses through actual observation. The students can correct the wrong concepts with the obtained new concepts. At this stage, the information is obtained by the students through analysis, comparison, opposition, and critic. This shows different things when discussing in small groups. All conflicts between the results of observations and hypotheses can be synchronized at the final stage (Explain II). This activity shows that PDEODE*E tasks involve the activities and potential of students, thus affecting their critical thinking abilities. The active learning model through experimental strategies can improve students' thinking skills (Yudanto *et.al.*, 2013; Sipin *et.al.*, 2016).

The students' activity is most prominent in terms of the way students discuss within their groups at the initial level of discussion and advanced discussion. In this stage, the students together with their groups exchange ideas about the problems (Sipin *et al.*, 2016). The discussion stage carried out by students can also foster a sense of tolerance in respecting the opinions of others. PDEODE*E tasks have several advantages including 1) students are given the opportunity to explore and develop their knowledge so that learning becomes more meaningful, 2)learners learn about the real phenomena experienced in everyday life, and 3) students construct their knowledge through practical activities that develop motivation and creativity. With all these advantages, students are able to improve their critical thinking skills. (Suartini *et.al*, 2016). The results of this study are also supportedby several research results that have been done before (Coştu, 2008; Suartini, *et.al.*, 2016; Mulyani *et.al.*, 2017).

CONCLUSION

Based on the results of the study, it can be concluded that learning using the ALBICI learning model (Active Learning Based Interactive Conceptual Instructions) with PDEODE*E Tasks is effective for students' critical thinking abilities on the momentum and impulses learning the material. Thus the implementation of the ALBICI learning model (Active Learning Based Interactive Concepts) with PDEODE*E Tasks is very helpful for students in improving students'critical thinking skills in the tenth grade. This can be seen from the average test scores of students' critical thinking skills of 69.5 and 49, the students' ability to think critically using the ALBICI learning model (Active Learning Based Interactive Concepts) with PDEODE*E Tasks is higher than the average test of critical thinking skills using conventional method.

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