THE EFFECT OF PROBLEM BASED LEARNING MODEL ON CRITICAL THINKING ABILITY OF STUDENTS IN DYNAMIC FLUID CLASS XI MIA SMA NEGERI 2 BALIGE ACADEMIC YEAR 2014/ 2015

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Abstract

The objectives of this research are: Analyzing how criticalthinking ability of students that learn using Problem BasedLearning and Direct Instructional Model in dynamic fluid and Analyzing is it critical thinking ability of students that learn using problem based learning model is better than direct instructional model in dynamic fluid in SMA Negeri 2 Balige Class XI MIA Academic Year 2014/ 2015. The type of research was Quasi-experiment with the population is all of students in plus class XI MIA in even semester in SMA Negeri 2 Balige which consists of 3 classes. Sample of this research was obtained by technique cluster random sampling. The sample is XI MIA 1 as the experimental class taught by Problem Based Learning Model and XI MIA 3 as the control class taught by Direct Instructional Model. The research instrument has 6 questions in essay type, the instruments tested validated. In this research obtained the average value of post test in experimental higher than control class. In hypothesis testing t count > t table at significant level α = 0.05. So, can be concluded that the critical thinking ability of students in experimental class better than in control class. Ha was accepted or has effect of Problem Based Learning Model on Critical Thinking Ability of Students in Dynamic Fluid Class XI MIA SMA Negeri 2 Balige Academic Year 2014/ 2015.

Key word: Problem Based Learning, Critical thinking ability, Dynamic Fluid.

INTRODUCTION

Physics is one of the branches of Natural Sciences, which is a science that studies the phenomena of nature and interaction in it. Physics is one of the important lessons for students. It is listed in the function and purpose of physics subject in high school, that the implementation of the physics subjects is to develop and train students to master the knowledge, concepts and principles of physics,

has scientific skills and critical thinking skills (Depdiknas, 2006).

Thinking is a necessary part of our social and intellectual lives. Fisher (2001) argues that the quality of our lives and learning depends on the quality of our thinking. Thinking is part and parcel of being intrinsic to human development and that we gain pleasure from being exposed to intellectual stimulus and challenge. Acquiring thinking skills has been increasingly emphasized in education, especially with forces in globalization demanding its workers to be adaptable over and above being productive. Studies have recommended that students can no longer be "passive recipients of given information" and called for changes in pedagogical and learning environments that are geared towards "developing thinking skills and harnessing creativity".Instead, schools should prepare students to be able to learn and think for themselves. And to do this, they need to be able to think "critically and creatively at the highest possible level" (Saeed& Nokhbeh, 2013).

One problem facing our education is the weakness of learning process. Student didn't encouraged to develop their thinking ability in learning process. Learning process in class toward to the ability of students to memories the information; Student's brain forced to remembering and be piled up on the information without demand to understanding the information to relate it to daily life. Finally, when students graduate from school, they clever as theoretically, but poor the application (Sanjaya, 2006).

Critical thinking is an ability to justify and reflect on what an individual believes. This, in light with Ennis (1991), points that critical thinking as a reasonable and reflective thinking that focuses on deciding what to believe or do. Critical thinking is an analytical process of arriving at judgments that is directed by a specific end purpose to arrive at alogical, rational, and reasonable problem solution. Some authors explain that critical thinking is the process of an individual taught to reason for improving the solution (Facione, 2006). Thus, the analytical process of reasoning must arrive at logical, rational, and reasonable judgments, within a given framework, and must agree with specific principles of thinking (Ennis, 1984).

According to Richard Paul (Fisher, 2001), Critical thinking is that mode of thinking–about any subject, content, or problem–in which the thinker improves the quality of his or her thinking by skillfully analyzing, assessing, and reconstructing it. It entails effective communication and problem-solving abilities. The process of critical thinking skills is inseparable from the understanding student's concept. To be able to think critically, students should have an understanding of a particular concept so that a good understanding of the concepts will support students' critical thinking abilities. Learning that stimulate critical thinking skill will increase the learning outcomes of students like understanding the matter or concept mastery.

Based on observations by the author in SMA Negeri 2 Balige when Integrated Field Experience Program, when teaching and learning process, teachers were more frequent use of direct teaching models with explaining the subject matter,

followed by giving examples that relate to the material, giving exercises and the latter giving the task to the students continued to work at home so that students learn physics oriented with practical formulas for directly solving the physics problems and less attention to the concepts of physics that exist in the problem. Learning models like this if it persists continuously can cause the perceived student learning less challenging and seem boring. Potential, creativity and ability that exist in every student also will not grow optimally in particular the ability to encourage students to think critically in understanding the phenomena of nature, or the application of the physics lesson.

One of the solutions to develop the critical thinking abilities of student is by using problem based learning model. Problem based learning model is a model of learning that is relevant to the physics lesson. In principle of Problem based learning model, students them selves who are actively searching for answers to the problems set by the teacher (Masek & Sulaiman, 2011).

The PBL stage begins with students performing an independent self-study (Nazir, 2010). Students are expected to master the knowledge that relevant to the problem to be solved. Then, students conduct a group brainstorming and discussion session. They exchange and share their information with all the learning issues and hypotheses should reach an acceptable definition that is agreed upon by all members. Meanwhile, the facilitator monitors the group's progress through direct observation and formative assessment. The direct observation involves coaching roles such as

probing and questioning, in order to trigger students' meta-cognition. The facilitator then provides feedback immediately after formative assessment and always encourages students to keep up with self-assessment. In the final stage, students prepares for a project presentation and assessment during the last meeting session. Students partially present their proposal of solution. The facilitator evaluates students' work based on either group or individual presentation (Kolmos and Holgaard, 2007). In some cases, peer assessment is used to modify the group's mark; leading to award students with an individual grades. Other methods of assessment are also employed in monitoring students' progress in learning.

Based on the background described above, the researchers interested in conducting research entitled" **The Effect of Problem Based Learning Model on Critical Thinking Ability of Students in Dynamic Fluid Class XI MIA at SMA 2 Balige Academic Year 2014/2015**".

RESEARCH METHOD

This research was done in SMA Negeri 2 Balige class XI MIA in even semester Academic Year 2014/2015 on 17 April – 2 May 2015 with a time of study tailored to the educational calendar for the implementation of the treatment in the learning process. Population in this research are students of Plus class of SMA Negeri 2 Balige that is XI MIA 1 – XI MIA 3 Academic Year 2014/2015 that consist of three class. Samples in this research are class XI MIA 1 and XI MIA 3. Samples technique is cluster random sampling. This research isa quasi-

experimentalresearch that isa research to know the effect that imposed to sample that is students.

The study involved two different sample classes that experimental class and control class. Group of students who were given learning problem-based learning model is experiment class. While the group of students who were given learning with Direct Instructional models is control class.

Table 3.1 Design of the Research

Class	Pret test	Treat ment	Postt est
Experiment	T_1	X	T_2
Control	T_1	Y	T_2

Where:
T_1: Test beginning (pretest) for the experimental class and control class
T_2: Test end (posttest) for the experimental class and control class
X: Treatment using Problem Based Learning model
Y: Treatment using Direct instructional model

Instrument used to measure the level of critical thinking abilities of students in this research are 6 questions in essay form. The selection of test is to reveal the critical thinking abilities of student more thoroughly the material that has been delivered after the second class learn. Ratings for each item on the test of critical thinking that is reference to the Holistic assessment based on some indicators by Ennis to measures critical thinking skills. Question in critical thinking skill test contain questions that demand student to able to giving a simple explanation, develop basic skill, conclusion, giving further explanation, and setting strategy and technique.

To get value of test, researcher first do scoring to the test that have been collected. After do scoring, the next step is valuing by using formula:
Critical thinking ability of students
$$= \frac{Amount\ of\ score\ get}{maximum\ score} \text{ x } 100\%$$

Value that have been calculate then tabulating in table below:

Table 3.3 Categories of Critical Thinking level of student

Stretches	Classification
$90\% \leq A \leq 100\%$	Very good
$75\% \leq B < 90\%$	Good
$55\% \leq C < 75\%$	Enough
$40\% \leq D < 55\%$	Bad
$0\% \leq E < 40\%$	Very bad

Source: Suherman in Prayoga (2013).

Data about critical thinking ability of students other than to measure the ability of critical thinking of students, it also measure the learning outcomes of students.

To find the data homogeneous or not then use homogeneity test (testing the equality of two variances) using the formula F test:
$$F = \frac{S_1^2}{S_2^2}$$

(Sudjana, 2002)

Where: S_1^2 = Greatest variance
S_2^2 = Smallest Variance
Criteria of testing:
If F$\geq F_{\frac{1}{2}\alpha(v_1, v_2)}$, so Ha can be accepted

To determine whether normal distribution of data relating to the use of data analysis Lilliefors test. To test the hypothesis test for pretest used t-test. T-test is used to determine the similar ability students

in both groups of sample. The hypothesis tested in the form:

Ho :$\mu_1 = \mu_2$

Ha :$\mu_1 \neq \mu_2$

μ_1 = is the average score of the experimental class of critical thinking ability

μ_2 = is the average score of the control class of critical thinking ability

If research data have normal distribution and homogeneity so t-test formula used is:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

(Sudjana, 2002)

Combined with a standard deviation:

Where: $S^2 = \dfrac{(n_1 - 1)S_1{}^2 + (n_2 - 1)S_2{}^2}{n_1 + n_2 - 2}$

$\bar{x}_1$ = The average value of Critical thinking ability in experiment class

$\bar{x}_2$ = The average value of Critical thinking ability in control class

n_1 = The number of samples in experiment class

n_2 = The number of samples in control class

S^2 = Variance combined class

t = Price t calculation

Criteria of Testing:

If $-t_{1-1/2}{}^{\propto} < t < t_{1-1/2}{}^{\propto}$ where $t_{1-1/2}{}^{\propto}$ obtained from the t distribution list dk = $n_1 + n_2 - 2$ and chance $1 - 1/2^{\propto}$, so Ho acceptable. For the other value of t, Ho rejected.

To test the hypothesis test for posttest use t-test one tail. One part t-test used to determine the effect of Problem Based Learning model on critical thinking abilities of student in Dynamic Fluid.

Ho :$\mu_1 \leq \mu_2$

Ha :$\mu_1 > \mu_2$

If the normal distribution of data variance homogeneous then testing the hypothesis in the research carried out by using a test with the formula:

If $S_1 = S_2$,

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

(Sudjana, 2002)

With $S^2 = \dfrac{(n_1 - 1)S_1{}^2 + (n_2 - 1)S_2{}^2}{n_1 + n_2 - 2}$

Criteria of Testing:

If t arithmetic $< t_{(1-\propto)}$ accepted Ho. Degree of independency for t distribution list is $n_1 + n_2 - 2$ and chance $(1 - \propto)$ with $\propto = 0.05$. For the other value of t, Ho rejected it means that there is the effect of Problem Based Learning on Critical thinking ability of student.

If $S_1 \neq S_2$, t-test formula used is

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1{}^2}{n_1} + \frac{S_2{}^2}{n_2}}}$$

Criteria of testing:

If t $\geq \dfrac{W_1 t_1 + W_2 t_2}{W_1 + W_2}$ with $W_1 = \dfrac{S_1{}^2}{n_1}$; $W_2 = \dfrac{S_2{}^2}{n_2}$ and $t_1 = t_{(1-\propto).(n_1 - 1)}$; $t_2 = t_{(1-\propto).(n_2 - 1)}$, so Ho rejected.

DISCUSSION

Effect of Problem Based Learning model can be seen from the difference of Critical thinking ability of students in experimental class that get 82 average value and in control class has 76. The existence of control class as a comparison reinforces that learning physics by using a model of Problem Based Learning is more effective in improving critical thinking ability. The test results showed that the hypothesis Ho is rejected and Ha accepted, meaning that the average critical thinking ability are taught using problem based learning model is higher than

the critical thinking ability of students who are taught by using Direct Instructional models.

Problem Based Learning Model is a student-centered learning. The hallmark of this study is the emphasis on the activity of analyzing and evaluating the issues through the investigation group, so that students are directed to build their own knowledge. Teachers only as a facilitator who guides and directs the student at the time of the investigation. This has an impact on increasing critical thinking ability of students. There are some things that cause critical thinking ability of students in the experimental class is higher. The most important thing is the process of learning in the classroom. The learning process is implemented by using a model of Problem Based Learning.

This learning model consists of 5 stages, namely:

(1) Orientation of students to the problem, in this stage students teach to know about problem. Problem that used in learning is the real problem linking to daily life that make students interest to learn and to asking in some perspective and to solving it need some integrated information from some source. This stage can develop basic skill of students that one of the aspect of critical thinking ability.

(2) Organize the students to learn, in this stage students were divided into several groups which allows to develop the skills of working together. At this stage, the teacher is not simply classify students into several study groups. The role of teachers in this study is as a facilitator and organizer that encourage students to participate and interact fully in learning activities.

Because the maximum interaction in the group will determine the success in problem solving. This stage can develop how students can interact with others.

(3) Guiding the investigation of individual and group, at this stage, the teacher in charge of encouraging students to collect data and carry out experiments. The aim is that students are able to gather enough information necessary to develop and construct their own ideas. For that teachers should know more about the problem posed to be able to guide students to develop critical thinking ability.

(4) Develop and present work, in this stage randomly selecting groups of teachers who have the task to present the results of the discussion, as well as providing the opportunity for other groups to respond. This activity is useful for investigate preliminary results and preparation of the students' understanding of the material presented. This stage is an event skills of students to dare to express and defend their opinions.

(5) Analyze and evaluate problem-solving process, in this stage teacher helps students analyze and evaluate problem-solving process they had done. At this stage, learners are required to make a final conclusion from the discussion that has been done. Expected after making the conclusion of learners have an understanding of the concept of the issues that have been discussed.

Based on the above description, the steps of problem based learning model can improve the ability of students to understand the concepts and the students are more active and critical in finding and selecting strategy in solving problems. Students can freely argue

with each other and exchanging ideas between students and students and students with teachers. It was an impact on increasing students' critical thinking ability.

Indicator of critical thinking ability according to Ennis (1993) has 5 aspect of critical thinking. For all aspects of critical thinking ability, problem based learning class has bigger percentage than direct instructional.

Table 4.2 Avarage Value for Each Indicator of Critical Thinking Ability

Indicators of Critical Thinking Ability	Gain of Students Value	
	Exper-iment Class	Cont-rol Class
Focusing a question, analysis the question and answer the question with explanation	0.8	0.4
Observing and considering a report on the result of observation	0.8	0.34
Deducing and consideration the result of deducting and making and determining the result of consideration.	0.7	0.45
Giving Assumption	0.52	0.36
Determining the action	0.55	0.29

In that table show that average value for experiment class has a good increasing than control class.

The result of this research also same based on the work of Alias Masek and SulaimanYamin that in the first trawl of the recent of Problem Based Learning research, there was a gap in determining the effect of Problem Based Learning on students' critical thinking ability. The existing result of previous research have been equivocal, so the available evidences were still inconclusive. Several studies that related Problem based learning and critical thinking resulted with positive findings, especially in higher educational context. This was illustrated by Semerci, in which the author studied the effect of Problem based learning on critical thinking for students in the Professional Education Course. The comparison was in favour of the Problem based learning group, students' critical thinking ability had increased after Problem based learning treatment. The critical thinking was measured based on students ability to focus and clarify the solutions, analyze, understand, and infer with self-regulatory assumptions.

After get the data from experimental and control class, so the first is analyzed the data by normality test and homogeneity test as describe below:

Normality Test

Before test of hypothesis, the first done is normality test with Liliefors test. Normality test of pretest and post test of experimental and control class using to know if the pretest and post test data has normal distribution. The result of normality test in experimental and control class described below:

Table 4.5 Normality test of Experiment and Control class

Class	Pretest data		Post test data	
	L count	L table	L count	L table
Exp	0.147	0.16	0.16	0.161

Con	0.160	0.16	0.103	0.161

Based on table 4.5, for the experimental class get the Lo = 0.147829 for pre test and post test get Lo = 0.16. In significant level α = 0.05 and n = 28 got L table = 0.161 so **L count < L table**. Then, in control class get the Lo = 0.160 and for post test get Lo = 0.103729 so **L count < L table**. So that, can conclude that the data from both of the sample are from the normal distribution.

Homogeneity Test

Homogeneity test is the test to know the population homogeny or not, or the meaning is to know are the sample in the research can be represented all population. The result can described below:

Table 4.6 Homogeneity Test of Pretest Data

Data	Variant	Pretest	
	Pre test	F count	F table
Exp	360		
Cont	374	1.04	1.88

Homogeneity test calculated with F test with α = 0.05 and n = 28, get F table = 1.88 and F count = 1.04 for pretest, so $F_{count} < F_{table}$, it means that the sample in this research is homogeny.

Hypothesis data testing is done using t test one tail. t-test one tail used to determine the effect of Problem Based Learning model on critical thinking abilities of students. Hypothesis test is a requirement that used to determine whether that Ha in research is accepted or rejected. Can describe below:

Table 4.7 t-Test Summary

Data	Mean	t-count	t-table	Conclusion
Exp	82			Has the effect of Problem Based Learning Model on Critical thinking ability of students
Con	76	3.24	1.70	

Based on the table 4.7, by comparing t-count and t-table obtained $t_{count} > t_{table}$ its 3.24 > 1.70, so Ha accepted and Ho rejected. Can be concluded that Problem Based Learning model has the effect to critical thinking ability of students on dynamic fluid in SMA Negeri 2 Balige Academic Year 2014/ 2015.

CONLUSION & SUGGESTION

Based on research result and data collection, can be concluded that Critical thinking ability of students that taught by using Problem Based Learning Model is better than taught by Direct Instructional model.

According to the data of critical thinking ability of students and the experience of author when applying the Problem Based Learning Model in class, so the author gives suggestion that learning with Problem Based Learning model requires considerable time and teacher can make the Problem Based Learning Model as an alternative in physics learning so as to improve students' critical thinking ability, so that learning goals easily achieved.

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