

# Using Problem Based Learning Model Assisted Visual Media to Improve High Conceptual Knowledge and Critical Thinking Ability in Senior High School

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**Abstract** This research aims to ; Analyzing the gain of high conceptual knowledge and critical thinking ability of students by using problem based learning model and conventional learning, Analyzes whether the gain of high conceptual knowledge and critical thinking ability of students that are taught by model learning problem based learning is better than students who are taught by conventional learning. This research is a quasi experiment research with two class pretest-posttest design. The research population is all students of class X MAN 3 Medan semester II academic year 2016/2017. The population for this research are 11 classes. The sample in this research was taken by two random classes consist of 80 students. Class X MIA-3 as an experiment class taught by problem based learning model assisted visual media consist of 40 students, Class X MIA-4 as a control class taught by conventional learning consist of 40 students. The instrument of this research used essay test for high conceptual knowledge and critical thinking ability that has been validated. The resulting data were analyzed using statistic t test. The results showed that: The gain average in the high conceptual knowledge of students taught by the problem based learning model assisted visual media is in high category and using conventional learning is in medium category. The gain average of critical thinking ability students using model problem based learning model assisted visual media is in the high category and using conventional learning is in medium category. The gain average of high conceptual knowledge of students taught by problem based learning model assisted visual media is better than taught by conventional learning. The gain average of critical thinking ability of students taught by problem based learning model assisted visual media is better than taught by conventional learning.

**Keywords:** *problem based learning model, high conceptual knowledge, critical thinking ability, visual media*

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## 1. Introduction

Education in Indonesia has always undergone a refinement that ultimately results in a quality product or educational outcome. Various efforts have been made in order to improve the quality and quality of existing education, So as to create the next generation of a reliable nation capable of facing various life challenges. These improvements and improvements include curriculum improvements in the education system, or something directly related to the practice of learning.

The 2013 curriculum requires students to more actively explore their abilities and be able to solve problems that level of thinking at a high level according to Bloom's taxonomy. High-level thinking skills by Anderson [1] consists of analysis, evaluation and creation. One of the dimensions of knowledge in the cognitive process is conceptual knowledge. In addition the 2013 curriculum also invites students to have high-level thinking skills one of them is the ability to think critically. Based on the

results of the survey, the learning so far has not trained students' high-order thinking skills, so that achievement is only at low cognitive level. To solve the learning problem Efforts should be made, among others, in the form of improved learning strategies, that is learning model expected to improve the thinking skills of high levels of high conceptual knowledge and critical thinking of students so as to achieve maximum results. The critically thinking ability is an activity of thinking done by operating the intellectual potential to analyze, make judgments and make decisions appropriately and implement them correctly [11]. According to Rosyada [13], critical thinking is the ability of students to collect various information and then make an evaluative conclusion from various informations. Critical thinking ability is very important to improve students' learning outcomes. According to Ennis [6] critical thinking indicators include providing simple explanations, building basic skills, concluding, explaining further and setting strategies and tactics.

Less active learning involving students leads to less balanced students' cognitive abilities. Most of the students

are also unable to relate what is learned to how the knowledge will be used or used. Of course, this tends to make the student accustomed to using only a small part of his potential or ability to think [16]. One of the learning models that can give students the flexibility to increase high conceptual knowledge and critical thinking ability is problem based learning model.

The problem based learning is a learning model where students are involved to deal with problems with the goal of enabling students to develop their own knowledge, develop inquiry and higher-order thinking skills, develop self-reliance and self-confidence. Problem based learning model is a learning model that involves students to solve a problem through the stages of scientific method so that students can learn the knowledge related to the problem and at the same time have the skills to solve the problem [3]. Problem based learning facilitates successful solving problems, communication, class work and interpersonal skills better than other approaches [15]. The problem based learning model begins with a problem related to the real life of students, In the process of problem solving students are responsible for self study in small class then students demonstrate what they have learned. The advantages of the problem based learning model are students trained to solve problems, build their own knowledge and have the ability to conduct scientific communication in discussions. The phases in the problem based learning model are student orientation on issues, organizing students for learning, guiding individual and class investigations, presenting the work, evaluating the problem-solving process.

The theory of learning that supports the model of problem based learning model is the theory of learning Piaget and Vygotsky. According to Piaget, a good pedagogy should involve giving the child to situations in which the child is independent in experimenting, in the broadest sense of the term trying everything to see what happens, manipulating signs, manipulating symbols, asking questions and finding their own answer, matching what he found at some point with what he found at other times, comparing his findings with the findings of other children. Piaget's theory fits the problem based learning that requires students to process the ready-made information in their minds and construct their own knowledge of the social world and its surroundings [3].

According to Vygotsky, intellectual development occurs when individuals are faced with new experience and challenging when they attempt to solve the problems raised by this experience. Learning takes place through social interaction with teachers and peers. Through the challenges and assistance of more capable teachers or peers, students move into their nearest development zone where learning takes place. The nearest development zone is a term for the zone between the students' actual development level and potential development level.

In addition, teachers should also consider the characteristics of each student to be interested, passionate and feel happy in learning physics. The learning process is a process of communication, in this process the teacher convey information in the form of messages to students, so that messages can be accepted by students with the optimal, Then the teacher can develop learning strategies by utilizing various media and learning resources [19]. In

this case the researchers chose the visual media as a medium of learning because the visual media is also a message delivery or information technically and creatively which displays the video, images / graphics and clear layout, so that the recipients of messages and ideas can be accepted goals that are adjusted to the age of students who can attract students in learning, So that learning will be fun and not saturate. So that problem based learning model assisted visual media can be applied more effectively and able to optimize the high conceptual knowledge and critical thinking ability of the students.

## 2. Method

This research is a quasi experiment research with two class pretest-posttest design. Population is all students of class X Madrasah Aliyah Negeri 3 Medan semester II academic year 2016/2017. The sample in this research was taken by cluster random sampling that is as much as 2 classes consist of 80 people. Class X-MIA3 as an experiment class taught by problem based learning assisted visual media consists of 40 students, X-MIA4 class as control class taught with conventional learning consists of 40 students in physic subject. The instrument of this research using essay test for high conceptual knowledge consist of 5 questions and critical thinking ability consist of 5 questions which have been validated. The resulting data were analyzed using t test.

## 3. Result

At the beginning of the research the two classes are given pretest which aims to determine the students' early ability in each class. The results of pretest and posttest of the experiment class and control class in detail can be seen in Table 1. After the sample applied different learning models obtained posttest results in both classes. The results of research with the application of learning model problem based learning (experiment class) and conventional learning (control class) are as follows:

**Table 1. Pretest dan Posttest Data**

Variable	Class	Pretest	Posttest	Gain
High Conceptual Knowledge	Control	36.45	72.20	0.56
	Experiment	38.05	77.00	0.62
Critical Thinking Ability	Control	36.33	73.30	0.58
	Experiment	336.85	76.85	0.64

Can be seen in Table 1. there is an increased in postes value for high conceptual knowledge and critical thinking ability by applying problem based learning model. Furthermore, the results obtained from pretest and postes are analyzed by high conceptual knowledge and critical thinking ability which can be seen in Table 2.

Furthermore, data from these pretest and posttest are related to the extent of their increase to high conceptual knowledge and critical thinking ability with normalized Gain. Gain is used to view increase of high conceptual knowledge and students' critical thinking ability.

**Table 2. Average score of students' answers to High Conceptual Knowledge**

No	Dimension of High Conceptual Knowledge	Average score High Conceptual Knowledge	
		Control class	Experiment class
1	Principle and Generalization	8.77	8.77
2	Classification and category	7.37	8.4
3	Theory, model and structure	6.46	7.07

**Table 3. Average score of students' answers to Critical Thinking Ability**

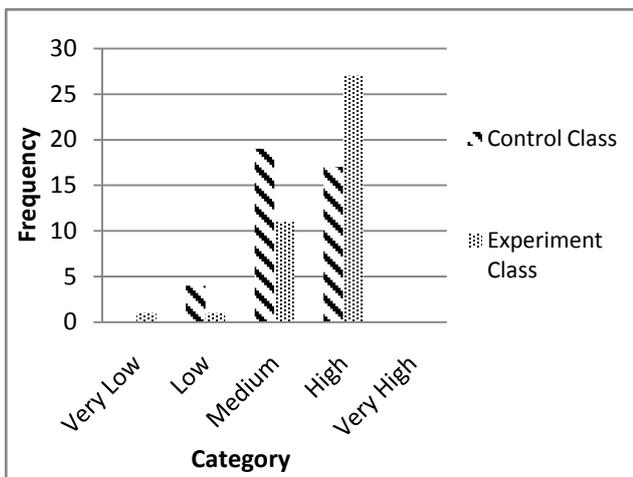
No.	Indicator	Average Score of Critical Thinking Ability	
		Control class	Experiment class
1	Providing simple explanations	8.5	8.5
2	Building basic skills	6.63	6.95
3	Concluding,	8.45	8.6
4	Explaining further and setting	6.59	7.35
5	Strategy and tactic.	7.45	7.7

Hake [8] state that gain score obtained have to normalized. So that can be seen in Table 4. Normalized gain categories.

**Table 4. Normalized Gain Score**

Gain Score	Gain Category
0.00-0.20	very low
0.21-0.40	low
0.41-0.60	medium
0.61-0.80	high
0.81-1.00	very high

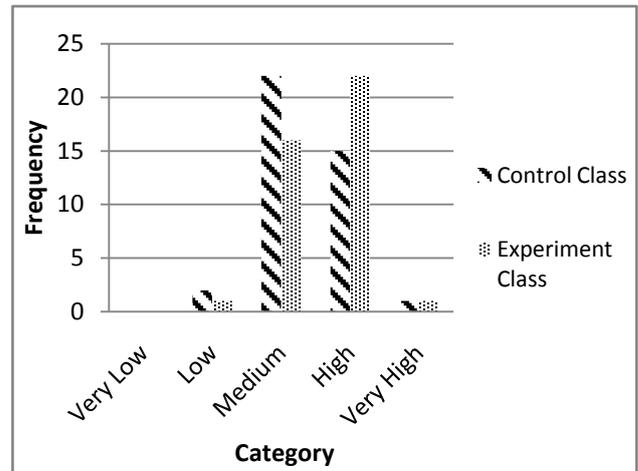
Gain category of students of control and experiments for high conceptual knowledge can be seen in Figure 1.



**Figure 1. Gain Distribution Analysis Students' High Conceptual Knowledge**

From Figure 1. Can be concluded that the students gain on high conceptual knowledge in the control class is in the medium category while the experiment class is in the high category.

The analysis of student gain categories in the control and experiment class for critical thinking ability can be seen in Figure 2.



**Figure 2. Gain Distribution Analysis Students' Critical Thinking Ability**

From Figure 2. Can be concluded that gain students on critical thinking ability in the control class is in the category while in the experiment class is in the high category.

After analyzing the increase, then testing the normality, homogeneity and similarity of two averages. The normality test of the gain data is used to determine whether the sample comes from a population that is normally distributed or not from the gain value of each student. Test of normality gain in control class and experiment class is done by Kolmogorov-Smirnov test using SPSS 16.0 program with significance level of 0.05 where normality test result is in Table 5.

**Table 5. Test Data Normality Gain High Conceptual Knowledge Experiment and Control Class**

Class	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
Experiment	.132	40	.076*
Control	.104	40	.200*

Based on the results of the normality output in Table 5. from significance value we obtained the result for high conceptual knowledge in the experiment and control classes with a value greater than 0.05, It can be said that the gain of high conceptual knowledge of the experiment class and the control class are normally distributed [18].

Testing the homogeneity of two data variance pretest of high conceptual knowledge between the control class and the experiment class was conducted by Levene test Through SPSS 16.0.0 program with significance level of 0.05. After the data processing, the output display can be seen in Table 6.

**Table 6. Two Variance Homogeneity of High Conceptual Knowledge in Experiment and Control Class**

Output	Levene Statistic	df1	df2	Significance
Gain of High Conceptual Knowledge	.001	1	78	.979

Based on the result of homogeneity test of variance by using Levene test in Table 6. For gain critical thinking ability gained significance value of 0.979. This shows that the value of significance is greater than the level of significance of 0.05. Then it can be concluded that the control class students and the experiment class come from populations that have the same variance, or both classes are homogeny.

Furthermore, the Gain Normality test of critical thinking ability of the experiment and control classes is obtained in Table 7.

**Table 7. Test Data Normality Gain of Critical thinking Ability Experiment and Control Class**

Class	Kolmogorov-Smirnov <sup>a</sup>		
	Statistic	df	Sig.
Experiment	.077	40	.200 <sup>*</sup>
Control	.110	40	.200 <sup>*</sup>

Based on the results of normality output in Table 7. Value of significance gained result Gain critical thinking ability of experiment class and control with value greater than 0.05, Then it can be said that gain critical thinking ability of the experiment class and control class is normally distributed

Testing the homogeneity of two data variance critical thinking ability between the control class and the experiment class was performed by the Levene test Through SPSS 16.0.0 program with significance level of 0.05.

**Table 8. Homogeneity of Two Variance Critical thinking Ability of Experiment and Control Class**

Result	Levene's Statistic	df1	df2	Significance
Gain of Critical thinking Ability	.658	1	78	0.420

Based on the result of homogeneity test of variance by using Levene test in Table 8. For Gain critical thinking ability gained significance value of 0.420. This shows that the value of significance is greater than the level of significance of 0.05. Then it can be concluded that the control class students and the experiment class come from populations that have the same variance, or both classes are homogeneous.

Hypothesis testing is done after the requirements of the feasibility test data is completed and met, then further testing hypothesis by using independent sample t-test with SPSS 16.0. Gain of high conceptual knowledge as well as critical thinking ability obtained were then calculated using t-test to see whether there is a difference in average increase of both class of samples.

**Table 9. Hypothesis Test Gain High Conceptual Knowledge of Experiment and Control Class**

Result	t	df	Significance. (2-tailed)
Gain of High Conceptual Knowledge	-2.126	77.292	0.037

The result of SPSS 16 calculation is obtained by the gain of high conceptual knowledge statistic using problem

based learning model assisted visual media and the result of high conceptual knowledge of students using conventional learning can be seen in Table 9.

Based on Table 9. the value of significance is obtained. By 0.037. Value significance 0.037 < 0.05, it can be said that the test results reject H<sub>0</sub> or receive H<sub>a</sub> in the level of alpha 5%, Thereby it can be concluded that high conceptual knowledge of students who are taught with problem based learning model is better than students who are taught by conventional learning in physics learning.

The result of SPSS 16 data obtained by statistic test gain ability of critical thinking of students using problem based learning model and critical thinking ability of students using conventional learning can be seen in Table 10.

**Table 10. Hypothesis Testing Gain Students' Critical Thinking Ability of Experiment and Control Class**

Result	T	df	Significance. (2-tailed)
Gain of Critical Thinking Ability	-2.288	75.812	0.025

Based on Table 10 the significance value obtained is 0.025 < 0.05, Then it can be said that the test results reject H<sub>0</sub> or receive H<sub>a</sub> in the level of alpha 5%.

## 4. Discussion

### 4.1. Average Gain The Ability of High Conceptual Knowledge Class of Students Learned by Using Problem Based Learning Model is better than Student Class Learned by Conventional Learning

The Average gain of high conceptual knowledge of the experiment class belongs to the high category while the control class is in the medium category. The higher average gain in the experiment class shows that the effect of problem based learning model on the increase of high conceptual knowledge of students in the experiment class. This better result occurs because the problem based learning model process encourages students to find answers to a problem. Students are given the opportunity to construct their own knowledge. Reciprocal with the results of research Sitorus [20] stated that there is a difference in the improvement of experiment class learning outcomes and control classes it caused by problem based learning model is more centered on the students so that students are more active to construct the knowledge directly through each activity that has been designed in the learning phase of problem based learning model.

Problem based learning model allows students to more understand the concept. Students' conceptual knowledge gained students through conceptual understanding, Attributing one concept to another concept so that students are able to present, formulate and identify the problems. The teacher presents the problem at the beginning of the learning to make the students challenged to find solutions through material concepts according to the problems

presented through various sources. In learning problem based learning model there are phases where students share knowledge, seek (inquiry) the knowledge actively so that there is increasing understanding (not memory). This is Reciprocal with the results of research Oktaviani, et al. [12] problem based learning model based on performance assessment applied in science learning can make students better understand the concept of science that is taught because the concept is found by the students themselves. In learning, students are actively involved in solving problems and to demand higher student thinking skills. The conditioning of students who learn in class who interact with each other towards teachers and friends can improve the achievement of learning mastery can be expected. Reciprocal with Macmath [9] the problem based learning approach model promises not only to build students' mathematical understanding but also to test students' conceptual understandings. Problem based learning model students build their own knowledge using prior knowledge. Students negotiate averageing with others, build their own learning and make connections with prior understandings and handle content in a variety of contexts. Students are more active in their own learning in the classroom than with traditional ideas.

Problem based learning model provides a way for collaborative inquiry. Collaborative inquiry is important to develop a cognitive process that is high conceptual knowledge one of them. High conceptual knowledge is part of the cognitive process dimension. Every thinking activity always involves cognitive processes. By using problem based learning model, the thinking process of students includes planning, hypothesis, using various perspectives, and working through facts and ideas systematically. Problem resolution also involves logical and critical analysis, the use of analogy and divergent thinking, creative integration and synthesis. The problem scenarios and sequences help students develop cognitive connections. Reciprocal with the results of El-Shaer [5] the increase in the average score of knowledge acquisition and retention of the experiment class rather than the average score of knowledge acquisition and retention of the control class is because problem based learning model helps students to improve thinking ability through various ways to study new topics. In addition, problem based learning model provides a conducive learning environment for developing critical thinking by stimulating student interest, creating averageingful discussions, exposure of thoughts and views of others and fostering an atmosphere of mutual trust and support.

Reciprocal with Bayat [4] Studying in teams gives students the opportunity to share their thoughts, check understanding, exchange ideas and communicate with other classmates. In collaborative learning environments, interaction among students helps to increase their motivation in the lessons as they engage in activities that are more interesting and averageingful to them.

Problem based learning model supported by the use of visual media makes students more able to interpret the message conveyed by the teacher but it can also increase the motivation and interest of students to the learning process. Reciprocal with the results of the study Supriadi [21] which states that by displaying things related to learning materials in the form of drawings and short films

so that students are more interested and enthusiastic in following the learning. In the learning of the students can build their own knowledge so that effective learning can be achieved.

#### **4.2. Average Gain The Ability of Critical Thinking Class of Students Learned by Using Problem Based Learning Model is better than Student Class Learned by Conventional Learning**

The average gain of critical thinking ability of student class learned by using the average gain of critical thinking ability of the experiment class belongs to the high category while the control class is in the medium category. The higher average gain in the experiment class shows that the effect of problem based learning model on improving students' critical thinking ability in the experiment class.

The critical thinking ability of students who are taught by the problem based learning model assisted visual media better than that taught with conventional learning because learning-based learning activities make students more active. Through problem based learning with heterogeneous class members allows students to exchange ideas, work together to solve problems that ultimately can improve critical thinking ability. It is this student activity that can train students' critical thinking ability. So as to give an impact on improving students' critical thinking ability. Reciprocal with the results of Anwar [2] there is an increase in the way students think critically by using problem based learning. This is because students are taught with problem based learning more enthusiasm and active discussion so that students can develop their critical thinking to solve problems. Reciprocal with the results of Setyorini [17] Learning-based model of problem based learning can improve students' critical thinking ability in submatting straight-circulated motion. Activity of students in the learning process can train students' critical thinking ability. The improvement of students' critical thinking ability is seen from the affective and psychomotoric result of the students who are improving.

In addition learning problem based learning model creates conditions conducive for students in developing their freedom of thought. This is Reciprocal with the results of Masek [10] problem based learning requires long-term exposure to encourage students' critical thinking ability. Students' critical thinking ability can be fostered by problem based learning model through problem solving process especially at class discussion stage. The problem based learning model has phases that help students to develop their thinking skills through a problem. The process of problem based learning model is characterized by the existence of problems (can be raised by students and teachers), Then students explore their knowledge of what is known and how to solve problems in class to help each other and collaborate in solving problems. This is Reciprocal with Fakhriyah [7] with problem based learning almost all students can analyze and identify problems encountered in the field. Students are fully involved in the learning process because students act as research subjects. Problem based learning helps students in developing their critical thinking ability. Model of

learning problem based learning model is one model that can help students develop thinking skills through authentic problems. Reciprocal with Sahyar [15] the problem based learning has an authentic problem aimed at training students to develop higher-order thinking skills.

Students who have low category gain are indicated because there is still inherent habits of students who are less active in constructing their own knowledge, But if the teacher often performs student-centered learning and conducts experiment or laboratory activities. Then the students will have a high spirit in improving learning outcomes. It's just that in those studies there is no visual media used in learning. And the result of student gain test for critical thinking ability not yet classified as high category. In this study, researchers include visual media in the early stages of learning problem based learning that is when the stage of student orientation to the problem. Then after obtained pretest and posttest data can be searched gain of each student. From the value of gain analyzed can be seen whether or not the influence of learning model problem based learning model to students' critical thinking ability. The higher gain test results are higher in the experiment class than the control class.

## 5. Conclusion

The average increase in high conceptual knowledge using conventional learning is in the medium category and for the average increase in critical thinking ability are in the medium category.

The average increase in high conceptual knowledge using the problem based learning model is in the high category and for the average increase in critical thinking ability are in the high category.

High conceptual knowledge of student physics using problem based learning model visual media better than the ability of students using conventional learning. This indicates that there is influence of learning model of learning based on visual media to the high conceptual knowledge of students.

Critical thinking ability of physics of student using problem based learning model assisted visual media better than with critical thinking ability of student use conventional learning. This shows that there is influence of learning model problem based learning model assisted visual media to students' critical thinking ability.

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