

The Effect of Project Based Learning (PjBL) and Self Regulated Learning toward Students' Critical Thinking Skill in Senior High School

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Abstract: This study aimed to know the effects of Project based learning to students' Critical Thinking skill, to know the effects of self regulated learning to students' Critical Thinking skill, and to know the interaction of Project based learning and self regulated learning toward Critical Thinking skill. This study used a quasi experiment with two group pretest posttest design. The population of this study was all the students grade X in Senior High School Negeri 1 Balige, North Sumatera academic 2016/2017. The sample selection by cluster random sampling namely X Science-1 grade as experiment class implemented Project based learning model and X Science-3 grade as control class implemented conventional learning. The instruments of the research were valid essay test of critical thinking skill and questionnaire of self regulated learning. From result of study was students' Critical Thinking skill taught by Project Based Learning better than conventional learning. Students' Critical Thinking skill have high self regulated learning better than students' Critical Thinking skill have low self regulated learning. Project based learning and self regulated learning have interaction to students' Critical Thinking skill.

Keywords: Project Based Learning, self regulated learning, Critical Thinking skill

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I. Introduction

Education is a conscious and planned effort to create an atmosphere of learning and learning process so that students are actively developing their potential to have spiritual power, self-control, personality, intelligence, noble character, as well as the skills needed and society. [1]. In Indonesia, at the Senior High School level, one of the subjects that is considered important to be taught as a separate subject that can grow critical thinking skills that are useful for solving problems in everyday life is Physics. [2]. Physics is one branch of science that underlies the development of advanced technology and the concept of living in harmony with nature. Physics is not enough if learned only by reading, imagining and or memorizing it. Physics with all the events in it will be meaningful if studied contextually. But most of the current physics learning process is limited to providing declarative knowledge in using the problem solving formulas as has been exemplified before. Consequently, students' ability in physics learning is limited to the ability to memorize a set of facts that the teacher presented does not lead to a conceptual understanding. Most of the students are also unable to relate what is learned to how the knowledge will be used or used. Of course it tends to make students accustomed to using only a small part of the potential or thinking skills and make students lazy to think critically and lazy used to independent thinking.

Critical thinking is one of the levels of higher-order thinking other than creative thinking, problem-solving skills, and decision-making. [3]. Fisher defines critical thinking as a skilled and active interpretation and evaluation of observation and communication, information and argumentation. [4]. Dwijananti said the critical thinker will evaluate and then deduce something based on facts to make a decision. [5]. Elder states through critical thinking, then one is able to gain knowledge, understanding, insight, and skills in a specific body content. [6]. Critical thinking skills are abilities that can be learned and will not develop well without any continuous and intentional learning and practice. [7]. In order for critical thinking skills to develop optimally, there needs to be a model that orientates learning on real issues that can create student involvement in teaching and learning processes to grow, develop learning independence and foster students' critical thinking skills. Learning model that can create student involvement in teaching and learning process to grow, develop self-reliance learn and grow student's critical thinking skill is studied by Project Based Learning model.

The Project Based Learning model is a process-centered, time-relieved, problem-focused learning, meaningful learning unit by combining concepts from a number of knowledge, discipline or field components. The Project Based Learning model is also an innovative learning model, emphasizing contextual learning with project use. Projects put students into an active role as problem solvers, decision makers, and document makers.[8]. In addition, Project Based Learning is able to train students' thinking processes that lead to critical thinking skills. The results of research conducted Sastrika shows there are differences in critical thinking skills between groups of students who learn with project-based learning model and groups of students who learn with conventional learning. [9]. Luthvitasari also stated that the project-based learning model influences the improvement of critical thinking skills and creative thinking skill of SMK students.[10]. The end result in learning is a product that is the result of the student group work.[11]. Student learning independence is an important part in the learning process, because knowledge can be had if studied first. Learning is doing, so there is activity in learning. Teachers provide teaching materials, while students seek and explore the material in accordance with the will and ability. Successful learning among others can be seen from the learning activities. The higher the learning activity of the students, the higher the chance of success of learning.[12].

II. Method

This research was a quasi experimental research with two group pretest-posttest design. The population of this research was second semester of class X academic year 2016/2017 at Senior High School Negeri 1 Balige, North Sumatera, Indonesia. The sample of this research were two classes that consisted of 60 student's by using class random sampling technique. Class X Science-1 was experimental class taught by PjBL model, class X Science-3 was control class taught by conventional learning. Variables of this research consisted of independent, moderator and dependent variable. The independent variable was PjBL learning model, moderator variable was self regulated learning and the dependent variable was Critical Thinking Skill. The treatment instruments were lesson plan, handout, and student workbook. Measurement instruments consisted of valid essay test of Critical Thinking Skill and questionnaire of self regulated learning that fulfilled validity and reliability requirements. The Critical Thinking Skill indicators consisted of five, namely elementary clarification, basic support, inferring, advanced clarification and strategy and tactics. The material was essay test of fluid static for second semester of class X. The data were analyzed by using prerequisite and hypothesis test. The normality test were analyzed by Kolmogorov-Smirnov Test. The homogeneity test were analyzed by Levene's Test of equality error variance. Hypothesis test were analyzed by using 2x2 factorial design for technical analysis of two way variance (ANOVA) with the level of significance 0.05.

III. Results

Student's critical thinking skill on control class and experiment class shown in Table 1.

Table 1. Pretest and Posttest data of students' critical thinking skill

Class	Average Student critical thinking skill	
	Pretest	Posttest
Experiment	16.37	60.80
Control	18.53	43.20

Based on Table 1, a description of the mean values of critical thinking skill of pretest and posttest students in the control class and experiment class is as follows: pretest in control class 18.53 and experiment class 16.37. Posttest control class 43.20 and experiment class 60.80. Problem analysis Posttest critical thinking skill is useful to look at the student critical thinking skill indicator which becomes difficult for students. Grain analysis of students' critical thinking skill of each posttest item given to the experimental class and control class can be seen in Table 2.

Table 2. Average Grade of Student Answers on Posttest

No	Indicator of Conceptual Knowledge	Percentage of Achievements	
		Control (%)	Experiment (%)
1	Elementary Clarification	56.76	71.50
2	Basic Support	39.49	56.67
3	Inferring	48.61	60.00
4	Advanced Clarification	46.37	58.77
5	Strategy and Tactics	32.44	58.47

Based on Table 2, the percentage of students achieving average scores who answered correctly in the matter of critical thinking skill of students in the experiment class is higher than the control class. The highest percentage of achievement for each indicator lies in the basic clarification, where the percentage of achievement of the experimental class is 71.50% and the control class is 56.76%. This is because the critical thinking skills indicator that is easy to solved by students because analyze the statement, filed and answered questions clarification. While the lowest percentage of achievement for the control class in the fifth indicator, namely strategy and tactics, where the percentage of achievement is 32.44%. This is because strategy and tactics includes assessing a source's credibility, researching, assessing research results. But in the lowest

achievement experiment class is the indicator of basic support where the percentage of achievement is 56.67%, this is because on the issues basic support include decide an action, interact with others. Data posttest of critical thinking skill of experimental class and control class are grouped by high self regulated learning group and low self regulated learning can be seen in Table 3.

Table 3. Two-way ANOVA

Student Self regulated learning (B)	Learning model (A)		Average
	Experiment (Project Based Learning) (1)	control (Conventional) (2)	
High (1)	64.58	43.36	53.97
Low (2)	54.27	43.10	48.68
Average	54.42	43.23	

Table 3 shows that the students' critical thinking skill is based on the level of self regulated learning in the experimental and control classes. In the experiment class it can be seen that the average value of the critical thinking skill of low self regulated students (54.27) is lower than that of highly self regulated students (64.58). In the control class the average value of critical thinking skill of low self regulated students (43.10) was lower than that of highly self regulated students (43.36). After the two classes were declared homogeneous, then continued on a two-way ANOVA test. Hypothesis testing in this study using two-way ANOVA to see whether or not interaction between variables studied namely critical thinking skill and student self regulated learning using SPSS 16.0 is shown in Table 4.

Table 4. Calculation of Two-way ANOVA

Source	Mean Square	F	Sig.
Intercept	146845.275	2.529	0.000
Learning Model	3652.777	62.918	0.000
Self regulated learning	388.777	6.697	0.012
Learning Model * Self regulated learning	351.675	6.057	0.017

Two-way ANOVA test results using SPSS 16.0 obtained grade significance of 0.000 where this value is smaller than the significant level of 0.05. This shows the model of learning in the experiment class that is project based learning better than the control class learning model that is the conventional learning model. Part of self regulated learning is obtained significant value equal to 0.012, because significant value $0.012 < 0.05$. This shows that the critical thinking skill of students who have high self regulated learning is better than low self regulated learning. Part of class * self regulated learning is obtained significantly by 0.017 where this value is smaller than significant value 0.05. This shows that there is an interaction between project based learning and self regulated learning to student's critical thinking skill. The graph of the relationship between project based learning and critical thinking skill at high self regulated learning level and low self regulated learning can be seen in Figure 1.

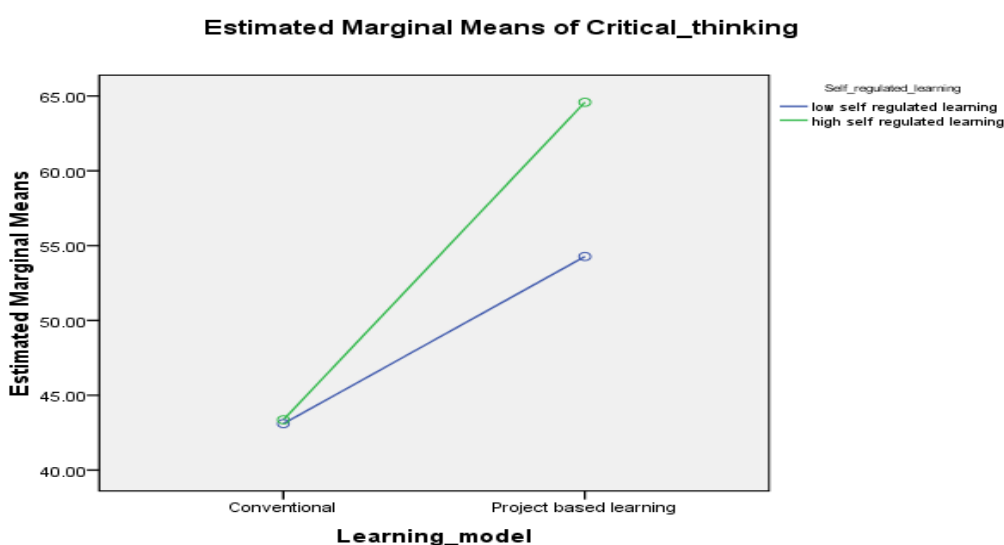


Figure 1. Interaction Model Learning and Self regulated learning

Fig 1. shows the interaction results between project based learning with conventional learning and high self regulated learning and low self regulated learning.

IV. Discussion

4.1. The Effect of project based learning toward Students' critical thinking skill

Based on the research results obtained the average value of critical thinking skill of students who are taught with conventional learning model when pretest by 18.53 with a standard deviation of 8.65 while the posttest of 43.20 with a standard deviation of 6.98. The mean value of critical thinking skill of students taught by project based learning in the experiment class when the pretest of 16.37 with the standard deviation of 7.57 while the posttest of 60.80 with standard deviation 9.43. Thus the critical thinking skill of students who are taught with project based learning model is better than the students taught by conventional learning.

Statistically the critical thinking skill of students taught by project based learning model is better than the students taught by conventional learning. The average value of critical thinking skill of the experimental class is 60.80 while the mean score for the control class is 43.20. When testing hypothesis with Anova test, obtained F Count of 30.929 and significant at 0.000 and this significance is smaller than significant level $\alpha = 0.05$. Then it can be concluded that the critical thinking skill of students in the experimental class is better than the control class. The findings of this study are similar to the results of the study of Yunus et al. (2015) using the method of true experimental design research with posttest-only control group design design said that there is a significant difference between the critical thinking ability of the group who learn to use the project based learning model with the mean at 16.59 and learning to use conventional learning with an average score of 13.00. [13]. The results of Insyasiska research (2015) with the non-equivalent research design Pretest-posttest control group design said that the improvement of conventional learning in the control class increased the critical thinking ability by 27.4% while the improvement of critical thinking ability in project learning in the experimental class was 61.8%. [14]. Furthermore, Nuryanti (2015) using quasi experimental design method with post-test design only said that project based learning model is more effective than problem based learning in improving students' critical thinking ability because they get average posttest value of critical thinking ability of experimental class. Using project based learning model equal to 58.74 while control class with problem based learning model equal to 52.19. [15].

4.2. Critical thinking skill of students who have high self regulated learning better than low self regulated learning

The results of the research analysis conducted by testing the data showed that the significance of self regulated learning obtained 0.012 significance smaller than the significance of $\alpha = 0.05$ with average critical thinking skill of students with high self regulated learning greater than with students with low self regulated learning. So it can be concluded that the critical thinking skill of students who have high self regulated learning better than the critical thinking skill of students who have low self regulated learning.

The result of this research is similar to the opinion of prasetyowati (2016) which based on t-test is obtained $t_{count} > t_{table}$ is $3.761 > 1.977$ and value of significance that is 0.000 smaller 0.05 say that self regulated learning have positive and significant influence there is critical thinking. [16]. In line with Oka (2011) research that uses a series of quasi-non-equivalent control group design research, it is said that there is an effect of applying self regulated learning strategy to improving critical thinking skill of Senior High school Teladan 1 Metro students. Students who are facilitated with self-learning strategies have a higher critical thinking ability of 80.111% of learners who are taught with conventional learning. [17]. Research from Linda Manova (2013) obtained the first conclusion: there is influence of learning model to critical thinking ability of class IX students of Junior High School Negeri 9 Kendari with value of Sig (α) = 0,020 $< \frac{1}{2}\alpha = 0,025$. Second: there is the influence of self regulated learning on the critical thinking ability of students of class IX Junior High School Negeri 9 Kendari with the value of Sig (α) = 0.010 $< \frac{1}{2}\alpha = 0.025$. [18].

Thus the better the self regulated learning someone will be the better the critical thinking skills in solving a problem. The findings of this study are in accordance with the theory that self regulated learning can improve students' critical thinking skills.

4.3. Interaction Between Project Based Learning and Self regulated learning on Critical thinking skill

Students who have high self regulated learning if taught by project based learning model will gain high critical thinking skill. Then it can be concluded that project based learning model media interact with self regulated learning in influencing critical thinking skill. This is in accordance with the results of research that statistically showed significant interaction between project based learning and self regulated learning in influencing student critical thinking skill obtained $F_{Counted}$ 6.057 and significant at 0.017 and this significance is smaller than level $\alpha = 0,05$. Thus the findings of this study in accordance with the results of research conducted by researchers and in accordance with the theory that project based learning is one model of learning designed primarily to help students develop critical thinking skill. Project Based Learning (PjBL) is an innovative learning model or approach, which emphasizes contextual learning through complex activities. PjBL is the use of the project in its learning activities. The projects put students into an active role as decision makers, researchers,

problem solvers, and document makers.[19]. Therefore, students must not only understand the concepts that are relevant to the issues that are the center of attention but also acquire a learning experience related to critical thinking skills applying scientific methods in problem solving and fostering patterns of learning independence.

V. Conclusion

Based on the results of analysis and discussion, it was obtained some conclusions as the following:

1. Critical thinking skill of students taught by project based learning better than Critical thinking skill of students taught by conventional learning. The result shows that there is influence of project based learning to student Critical thinking skill.
2. The Critical thinking skill of students with high self regulated learning is better than the Critical thinking skill of students with low self regulated learning. The results show that there is influence of self regulated learning to students' Critical thinking skill.
3. There is an interaction between cooperative learning model of group investigation type with animation and self regulated learning in improving students' Critical thinking skill.

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