



## Critical Thinking Ability of Senior High School Students in terms of Mathematical Self Efficacy in Project Based Learning with Project Assessment

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### Abstract

This study has objectives to determine the effectiveness of project-based learning on critical thinking skills in terms of students' mathematical self-efficacy and to find out critical thinking skills in terms of students' mathematical self-efficacy in project-based learning. This research was conducted at MAN 1 Semarang in academic year of 2019/2020. The researcher used mix methods with sequential explanatory. The research data were taken by means of questionnaires, observations, and tests then those were processed by completeness test, comparative test, influence test, and improvement test. The results showed that project-based learning was effective against critical thinking skills in terms of students' mathematical self-efficacy. Students with high mathematical self-efficacy have excellent critical thinking skills. Students with moderate ability in mathematical self-efficacy are having good critical thinking skills. Students with low mathematical self-efficacy have quite good critical thinking skills even though some of them did not achieved the minimum completeness criteria (KKM). The project-based learning model is suitable for improving students' critical thinking skills in terms of students' mathematical self-efficacy with high, medium, and low dimensions with a different time allotment for each dimension.

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## INTRODUCTION

In accordance with the competencies that must be achieved in mathematics learning according to Permendikbud No.64 of 2013 concerning Content Standards of Primary and Secondary Education must be logical, critical, analytical, creative, careful and thorough, responsible, responsive, and never give up easily in solving problems. The ability to think is needed to analyze problems so as to get a solution.

Learning activities in schools tend to teach students by giving one correct answer so that students cannot develop their thinking by generating new ideas according to their abilities. Students cannot freely express their thoughts on problems so that students cannot develop their critical thinking. Research conducted by Santrock (2011) also revealed that there are still few schools that teach and develop critical thinking skills in learning.

The problem of critical thinking skills also occurs in MAN 1 Semarang. Based on the results of preliminary observations on 34 students, the results of observations showed that 26.47% of students were able to solve math critical thinking problems and 73.53% of students were still unable to solve the problems given.

Critical thinking is a systematic process that allows a person to formulate and evaluate their own beliefs and opinions (Hendriana et al., 2017). Critical thinking is a mental activity in examining and analysing, evaluating certain problems using logic, systematic, reflective, and focus on how to get a solution to a problem (Rochmad, 2018). According to the Ministerial Council on Education, Employment, Training and Youth Affairs (MCEETYA) students who are able to think logically and deeply, obtain and evaluate evidence regularly as a result of learning, these students are categorized as successful students. Moreover, they also become someone who is able to understand their world and think about their way of things (Lloyd, 2010). Critical thinking is the most important skill in facing challenges and solving problems in everyday life (Sulistiani, 2017). Indicators of critical thinking skills according to Watson and Glaser (2008) are inference, recognition of assumptions, deduction, interpretation of information, evaluation of arguments,

In addition to students' critical thinking skills, mathematical self-efficacy really needs to be improved in learning. According to Alwison, self-efficacy is a person's view on a good or bad consideration, right or wrong, being able or unable to do something as required (Hendriana et al., 2017). The mathematical self-efficacy measurement refers to the three dimensions that have been described. From these dimensions, there can be several mathematical self-efficacy indicators as in Table 1 as follows.

<b>Di</b>	<b>Indicator</b>
<b>mension</b>	
<i>Mag</i>	1. Being optimistic in studying Mathematics assignments
<i>nitude</i>	2. How curious onto the lesson and assignment of Math
	3. Improving mathematics ability
	4. Making a plan in accomplishing Math assignment
	5. Unsure to solve the problem
	6. Not seeing the difficulty of assignment as a challenge
	7. Studying in unspecific time schedule
	8. Being selective to get the willingness
<i>Stre</i>	9. The effort can improve the achievement
<i>nghit</i>	10. Not having commitment in completing the assignment
	11. Pesimistic and not aware to their strength
	12. Not hardly work in completing
	13. Having positive aims to do something
	14. Highly motivated in self-improvement
<i>Gen</i>	15. Not respond the situation positively
<i>erality</i>	16. Making the past experience as the say to ger success
	17. Finding unusual way to solve Mathematic problem
	18. Not effectively control any situation
	19. not interested to a new challenge

Based on the results of interviews related to students' mathematical self-efficacy, the teacher explained that there were still many students who were hesitant in solving the problems or questions given when they encountered difficulties in solving them, students gave up without any effort to solve these problems. Students' optimism when learning mathematics is also lacking.

In connection with the things that happen about the ability to think critically and good mathematical self-efficacy in students so that satisfactory results are obtained and the learning objectives can be achieved. Therefore, learning is carried out with Project Based Learning combined with Project Assessment.

Project Based Learning is a learning model that organizes classes in a project (Thomas, 2000). Meanwhile, George Lucas Educational Foundation 2005 in Condliffe et al (2017) defines as a dynamic learning approach in which students actively explore problems in the real world, provide challenges, and gain deeper knowledge. Based on some definitions of those experts, it can be concluded that Project Based Learning is a student-centered learning model to build and apply the concepts generated by exploring and solving problems in the real world independently.

Project-based learning model with project assessment is a learning model that provides the opportunity for teachers to manage classroom learning by involving project assessment. A learning process is a series of activities consisting of planning, teaching and learning activities, and evaluation. Teaching and learning activities are designed in the form of a teaching plan prepared by the teacher with reference to the goals to be achieved. To determine the success or failure of the expected goals, the teacher needs an evaluation. Project assessment is an assessment activity for an assignment that includes several competencies that students must complete within a certain period (Masrukan, 2014).

Each learning evaluation model must have assessment criteria so that the assessment that will be applied later is really able to assess and measure students' abilities not only from one aspect, for example from the cognitive aspect, but from several aspects. In addition, there is a need for a truly objective assessment. In this study, researchers used a

project-based learning model combined with a project assessment.

Based on the previous description, the problems of this study are: Is project-based learning effective for critical thinking skills in terms of students' mathematical self-efficacy? and how is the analysis of critical thinking skills viewed from students' mathematical self-efficacy in project-based learning?

## METHODS

This research uses a mixed methods research (a combination of quantitative and qualitative). According to Creswell (2013) a combination research method is a study that combines quantitative and qualitative forms that involve philosophical assumptions. The application of qualitative and quantitative approaches by combining two approaches in a study. The combination model used in this study is a sequential explanatory research design. This strategy can be characterized as a mixed methods strategy that implements the stage of collecting and analyzing quantitative data then collecting and analyzing qualitative data.

This research was conducted at MAN 1 Semarang in the even semester with derivative material. Class XI MIPA 2 as an experimental class that used Project Based Learning with Project Assessment and class XI MIPA 1 as a control class that used Problem Based Learning. The variables in this study were critical thinking skills and mathematical self-efficacy. The data collection technique of this research was conducted by testing critical thinking skills. The test of critical thinking skills in mathematics will be conducted twice; before the research (pretest) and after the research (posttest). Meanwhile, to measure students' mathematical self-efficacy, observation and interview sheets were used.

Technique of data analysis on students' critical thinking skills in the experimental class and control class used the prerequisite tests; the normality test and the average similarity test. While the analysis of hypothesis testing used data on the final critical thinking skills, including the test of the proportion of student completeness, the test of the average difference between the control class and the

experimental class and the test for the improvement of students' critical thinking skills.

## RESULTS AND DISCUSSIONS

The results of data analysis show that the two samples come from a population with a normal distribution and there is no significant difference in the mean. Thus, both samples have the same conditions. In general, the condition of students' critical thinking skills in mathematics is still low.

Based on these results, it is known that the students have tried to answer the questions well but they are not in accordance with the critical thinking steps by Watson and Glaser. Most of the students answered questions with only short filling. A small proportion of students answered with several critical thinking steps but incomplete. According to the results of the interview, the majority of students were used to answering questions with short entries, including answering critical thinking questions that teachers usually asked for answers in long descriptions.

In addition, students' mathematical self-efficacy is also low. This is indicated by the results of students' mathematical self-efficacy questionnaire before they are given Project Based Learning with project assessment. The results of the questionnaire show that the average score of the questionnaire ranges from 62 out of 120, so that it can be concluded that the most likely students will answer score 2 from the maximum score of 4 in average.

Furthermore, after learning Project Based Learning with project assessment is applied to the experimental class, students are given a post-test so that the final data is obtained regarding the students' critical thinking abilities. Based on the post-test results, the following results were obtained.

In the minimum completeness test of the experimental class using the one sample T-test using SPSS, it was obtained  $\text{sig} = 0.000 < 5\%$ . Because the  $\text{sig}$  value  $< 5\%$ , then  $H_0$  is rejected and  $H_1$  is accepted. This means that the average value of students' critical thinking skills who received PjBL learning with Project Assessment reached the limit of completion.

In the proportion test, data was obtained that students who reached the completion limit were 28

students, of the number of students in the experimental class as many as 34 students. Therefore, the data obtained by the value  $z_{\text{count}} = 2.257$ . Z-table value = 1.645. Because the value  $z_{\text{count}} > z_{\text{table}} = 2.257 > 1.645$ , then  $H_0$  is rejected. This means that the proportion of completeness of students' critical thinking skills taught with the PjBL model with Project Assessment is more than 74%, it is 82.35%.

In the one-way ANOVA test used to test the average difference in critical thinking skills in class through PjBL learning with Project Assessment with Problem Based Learning, data  $F_{\text{count}} = 98.127$ . The value of F table with degrees of freedom  $\alpha = 5\%$ , dk numerator 1 and dk denominator 58 is 4.01. Based on the test criteria, because  $F_{\text{count}} \geq F_{\text{table}}$ . This means that there is a difference in the average critical thinking skills in the class through PjBL learning with Project Assessment and also with Problem Based Learning.

The average value of students' critical thinking skills who were given PjBL learning with Project Assessment was 80.17. Meanwhile, the average value of students' critical thinking skills who were given PBL learning was 71.

The regression test was carried out to see the effect of mathematical self-efficacy on students' critical thinking skills in the class given PjBL learning with Project Assessment, obtained data  $\text{sig} = 0,000 = 0\% < 5\%$ . Because the  $\text{sig}$  value  $< 5\%$ , then  $H_0$  is rejected and  $H_1$  is accepted. It means that there is an influence between mathematical self-efficacy characters on students' critical thinking skills in the class given PjBL learning with Project Assessment.

The regression line equation can be expressed in the following equation:  $Y = 16.782 + 0.831X$ . The equation shows that the mathematical self-efficacy coefficient value is 0.831 which means that if the mathematical self-efficacy value increases one unit, the value of students' critical thinking skills in derived material will increase 83 1%.

Furthermore, in the improvement test, the results of the gain index calculation showed that in the experimental class, 100% of students who were given PjBL learning with Project Assessment get an improvement. With details, 2 students experienced a low increase, 23 students experienced a moderate increase, and 3 students experienced a high increase.

By analyzing the result of interviews, that the success is the formation of enthusiasm for learning by using the Project Based Learning model with Project Assessment.

To analyze students' critical thinking skills, students' critical thinking skills tests and interviews were conducted. The test of students' critical thinking skills is carried out after students are given learning with Project Based Learning with Project Assessment. While interviews were conducted on six research subjects, there were 2 students with high mathematical self-efficacy, 2 students with moderate mathematical self-efficacy, and 2 students with low mathematical self-efficacy.

The analyzed students' critical thinking skills include five indicators of critical thinking skills according to Watson and Glaser, those are inference, recognition of assumptions, deduction, interpretation, analysis of arguments.

In students with high mathematical self-efficacy, They are very good at inference. In the indicators of assumptions (recognition of assumptions) and deduction (deduction) are quite good, and interpret the information very well. And in analyzing arguments (evaluation of arguments) is also very good. Previously students often answered with short answers or accompanied by solving questions without including indicators of critical thinking skills. Then after being given this lesson, students understand the indicators of critical thinking skills in solving problems of critical thinking skills in mathematics.

Students with moderate mathematical self-efficacy, in inference, recognition of assumptions and deduction they perform well. In the indicator of interpreting information, analyzing the evaluation of arguments is quite good. Previously students often answered with short answers or accompanied by solving questions without including indicators of critical thinking skills as well. Then after being given this lesson, students understand the indicators of critical thinking skills in solving problems of critical thinking skills in mathematics. However, this group of students did not have enough time to analyze their arguments due to lack of time.

In students with low mathematical self-efficacy, in inference, recognition of assumptions and deduction students perform quite well. In indicators

Interpreting information (interpretation) Analyzing arguments (evaluation of arguments) is quite good too. Previously students often answered with short answers or accompanied by solving questions without including indicators of critical thinking skills as well. Then after being given this lesson, students understood the indicators of critical thinking skills in solving problems of critical thinking skills in mathematics. However, this group of students did not have enough time to analyze their arguments due to lack of time and there were still some unsuitable steps for solving them.

Based on the analysis of the critical thinking ability test of class XI students of MAN 1 Semarang, it shows that there is a relationship between students' mathematical self-efficacy and students' critical thinking skills. Students with high mathematical self-efficacy are categorized as very good at critical thinking, students with moderate mathematical self-efficacy are categorized as good in critical thinking skills, and students with low mathematical self-efficacy are categorized as good enough in critical thinking skills.

Even so, there are a small proportion of students with high mathematical self-efficacy who have moderate critical thinking skills. And there are also students with mathematical self-efficacy who have high and moderate critical thinking skills. And there are also students with low mathematical self-efficacy who have medium and low critical thinking skills. This is influenced by learning activities, intelligence abilities, and different environments.

## CONCLUSION

The PjBL learning model with Project Assessment is effective against students' critical thinking skills, this is proved by the fulfilled effectiveness test. Students with high mathematical self-efficacy have excellent critical thinking skills. Students with mathematical self efficacy are having good critical thinking skills. Students with low mathematical self-efficacy have pretty good critical thinking skills even though some of them do not complete Criteria of Minimum Completeness (KKM).

## SUGGESTION

Learning model using Project Based Learning with Project Based Learning can be used on materials related to algebra. Teachers are expected to be able to make students have mathematical self-efficacy because the attitude of student confidence in mathematics affects students' mathematical performance. The use of mathematical models and improving mathematical self-efficacy are tools in this study. These two aspects affect the main focus of this research, it is the achievement of students' critical thinking abilities.

Students with low Mathematical self-efficacy can be helped by getting them used to in a learning that invites students to be active, interact with each other and communicate with peers. So that they improve self-confidence and express difficulties experienced more easily because of their peers.

Students with high mathematical self-efficacy should study or discuss together with students who have low mathematical self-efficacy. As a result, they can help these students to overcome difficulties faced by discussing.

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