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The Process of Critical Thinking Ability in the PBL Model Viewed from Independent Learning

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Abstract. Critical thinking ability is a tool that can be used to face challenges and survive. In addition to critical thinking skills, there are also affective aspects that need to be developed in learning activities, namely self-learning aspects. Independent learning will have a significant impact on student learning outcomes. This study aims to describe the process of mathematical critical thinking and identify the level of students' mathematical critical thinking given to learning mathematics. This study used qualitative research methods. The research subjects were 10 students who were taken from 33 high school class X students who were selected based on their initial mathematical ability. Research instruments include researchers, critical thinking tests, and interview guidelines. The data collection technique used consisted of critical thinking tests and teacher and student interviews. The data analysis technique used in this study is data reduction, data presentation, and drawing conclusions. The results showed that students who are independent in learning have the ability to think critically because these students can fulfill all stages of critical thinking when solving a given problem.

Key words : Critical Thinking Ability, PBL, Independent learning

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INTRODUCTION

Basically, the process of students' critical thinking skills has three stages, namely: (1) understanding formation, (2) opinion formation, and (3) drawing conclusions. In learning mathematics requires students' criticality in order to be able to solve problems. The ability to think critically is one of the tools that can be used to face life's challenges. In addition to critical thinking skills, there are also affective aspects that need to be developed in learning activities. The affective aspect that needs to be developed is independent learning. Independent learning will have an impact on student learning outcomes. (Mustaji, 2012) Critical thinking is reasoned and reflective thinking by emphasizing making decisions about what to believe or do. The following are examples of critical thinking skills, for example (1) comparing and distinguishing, (2) making categories, (2) examining small parts and the whole, (3) explaining causes, (4) making sequences, (5) determine reliable sources, and (6) make predictions. Critical thinking is an action think which direct student for capable analyze with dig potency intellectual and consider to be right in making a decision (Zunanda & Sinulingga, 2015). Students' critical thinking is when students are able to review opinions with the knowledge possessed and think to make decisions and solutions in solve something problem which very effective from solution other which given (Auliana et al., 2019). However, the reality is that in the learning process students are less independent to learn on their own and less critical in solving problems (Rinesti et al., 2019). We need a learning model that can really train critical thinking student namely PBL. (Walker, 2006): Critical thinking is an intellectual process in conceptualizing, applying, analyzing, synthesizing, and or evaluating various information obtained from observations, experiences, reflections, where the results of this process are used as a basis when taking action.

The PBL model is a model in the lesson that is more interesting than just read or listen something fact and draft which stay on part studies academic, in this can make students able to solve a problem even though in situation foreign (Susillo, 2012). (Chance, 1986) Critical thinking is the ability to analyze facts, generate and organize ideas, defend opinions, make comparisons, draw conclusions, evaluate arguments and solve problems. Model PBL also could grow think critical students too develop knowledge with method solve something problem and make Students are able to build their own knowledge and are able to develop independence students also social skills. These

independence and social skills when students able to solve identifying a problem by collaborating with friends in the form of groups, have the right ways and learning resources (Farisi et al, 2017).

Mertes (1991) Critical thinking is a conscious and deliberate process used to interpret and evaluate information and experiences with a number of reflective attitudes and abilities that guide beliefs and actions. Besides model PBL which influence think critical student is independence study. Independent learning is a process of self-direction for academic skills by method change mental and character. Independence study that is with existence ability give response to individual, balance position in something reject measuring as well as able to observe by monitoring the individual and also the motivation that is instilled in oneself (Sugandi, 2013). Paul (1993) Critical thinking is a mode of thinking – about any matter, substance or problem – in which the thinker improves the quality of his thinking by skillfully dealing with the structures inherent in thinking and applying intellectual standards to them. Very required for develop independence study on self someone to get better work results, can monitor, consistently manage time, save time and efficient in completing tasks and definitely get results satisfactory (Hope, 2017). Halpern (1985) Critical thinking is cognitive empowerment in achieving goals. Independent learning is a skill of individual behavior to be able to take the initiative to be able to face problems in order to have high self-confidence (Pramana & Dewi, 2014).

Independent learning is wrong one component of the individual in order to increase the absorption of students so that this factor very useful for developing skills from students so that this factor is very important for increase quality in progress learning (Azizah et al, 2018). Learning independence is an intention that each individual student has to be able to compete and advance in developing themselves and being able to settle on an action and creative in solve problem which got (Yuliasari, 2017). Theory which which used in the research is Trigonometry on the grounds that the material Trigonometry is Theory which more dominant for analyze, so that make students able to work independently in improving their critical thinking by how to solve the problem.

METHOD

The approach used is a quantitative approach. The population of the study is all class X students at SMA Negeri 1 Paguyangan. Sample selection method with *Cluster Random Sampling (CRS)* and class X IPA1 became the experimental class and class X IPA 2 was the class control. Techniques for collecting data using two steps, namely *pre-test* and *post-test*. *Pre-test* was conducted in order to determine the initial ability of students in both classes researched. *Post-test* conducted for knowing criticality student with method To do test hypothesis with use formula statistics t-test. As for condition which worn for The test data are normality and homogeneity test data. normality test is necessary so that could knowing is sample normal. Working is sample have variance which same.

RESULTS AND DISCUSSION

Based on the results of research that has been done on students' critical thinking data, it is obtained after students were given a test on the material of Trigonometry and trigonometric equations for the two classes used different models. The results of student work are taken from the highest grade and the lowest grade in the next class calculate the average value of the class under study. The highest value in the PBL model is 85 then the highest value in the conventional model is 75. The lowest value in the PBL . model is 63 and the conventional model is 55. The average value of the PBL model is 74.73 and the average value of the conventional model 72.23. For determine score tall and low value on sample is with take sample 33% from the top and 33% from the bottom. According to the number of students 33 means 1/3 of the 33 students are11 for high class and 11 for low class. After determining high independence and low independence of the two classes obtained the average value in both classes. Data The data was tested using *SPSS 26.* The following are the students' critical thinking data according to: learning model

Difference Thinking Ability Critical Student Among Student which UsePBL and conventional

Table 1. Critical thinking model PBL and conventional

Sample class	Number of samples	The highest score	Lowest value	Average

Experiment	33	85	63	74.73
Control	33	75	55	72.23

Based on the results of the hypothesis analysis, it shows that there is no difference in ability students' critical thinking is done with PBL with conventional learning. The effect of the learning model can be seen in the results of the 2-way ANOVA test analysis with using SSPS 26 obtained at the sig level 0.140> 0.05. Test Criteria (= _ 0.05), if sig > 0.05 means 0 _ = received, if sig < 0.05 means 1 _ = received. From result test calculation that score sig > 0.05 so 1 _ received could interpreted no There is a difference think critical student Among which use model PBL with model conventional .

PBL and conventional learning models the two models in line able to make students think critically. Same with research (Kurniahtunisa et al., 2016) that the PBL learning model can indeed improve students' critical thinking skills as well as conventional models, can make students think critically (Nurrohmi et al, 2017). From both With this model, the percentage difference in improving critical thinking can be seen in Table score comparison based on critical thinking indicators from the two classes in the table under this:

Table 2. Indicators of critical thinking in the experimental class (PBL) and the control class (conventional)

No	Critical thinking indicator	Percentage of students' critical thinking (%)	
		PBL	Conventional
1	Give an explanation	30	28
2	Conclusion	20	20
3	Advanced explanation	30	28
4	Strategy	10	10
5	Building skills	8	10

Based on the table above on indicator 1 model PBL more tall from conventional learning model. This factor cause there is no difference in critical thinking in students is that both have stages which leads to the development of students' critical thinking, namely in the first stage of the model learning PBL is orient on one problem then student given problems at the beginning of the learning process have been planned so that they can be solved. On step In this way, students are trained to think and be able to work independently at the beginning of completion problems given by the teacher. This refers to students who are able to hone their skills have for get solution from a problem as well as get draftthe new one. The same is done in the conventional model is ask questions at the beginning of the lesson that hone students to know related Theory which will studied. In step beginning this student formed in teams of 5 people per group. In this case, students are also able to empower ability he thought.

In the second step the PBL model is to organize students in study groupsand the teacher groups the students into several groups. Each group is divided Becomes 5 person. Student seen attempted with maximum use ability thinking that is owned to find the concept of the problem. In the conventional model that is, the teacher motivates students by presenting story questions and ask students to be able to practice critical thinking students by answering question the.

In the third step PBL learning model is to guide inquiry group. The teacher invites students to take part and interact with their inner friends group discussion. In conventional model is the teacher monitoring students in collecting data. In this case students are given a module with the aim that students understand The module. The teacher only monitors students in collecting the data as well asguide studentsif there is difficulty. From second model this teacher only limited monitor and self-guided and problem solving. From this solution, you can make student to practice think critical.

The fourth stage of the PBL learning model is to develop and present results discussion and determined representative group so that explain or report results profession group and group other directed for give response and teacher provide reinforcement to important concepts. In conventional model is that students manage data,

in this case students discuss back or reprocess the results of discussions that have been carried out in the teacher group as a guide in processing data and help participants educate for prepare results appropriate work.

In the fifth stage of PBL is to analyze and evaluate the process of solving problems problems where other groups can respond to the presenting group The teacher resubmits the problem at the beginning and provokes students to try to answer problem the with draft which they could and teacher evaluate answer student. In conventional model is proof of student findings by using teacher's way determine one group to present and another group requested to respond to the results of their friends' presentations and the teacher reinforces the concepts the important one. Of these two models both direct students are more dominant, find out themselves and analyze and compare their work and that of their peer group in different ways ask when something is not understood. Therefore it can be concluded that both This model is able to make students think critically. Where students are involved so that students are able to give explanation simple, conclude, give explanation carry on, arrange strategy and tactics as well as building skills base. (Zunanda & Sinulingga, 2015).

In the implementation of the PBL learning model students are given the following problems: related with life real in daily then student by group looking for alternative solutions to investigate these problems because PBL is a can make students always challenged to always learn, work together in teams when look for solutions to real problems and these problems are used as benchmarks to improve flavor curiosity as well as ability analyze from initiative on Theory lesson (Wulandari & Surjono, 2013). The teacher only directs students to problems and discussions together with groups and conduct practicum and present the results of group discussions in the classroom ahead of other groups (Farisi et al, 2017). Angelo (1995) Critical thinking is applying rational, higher thinking activities, including analyzing, synthesizing, recognizing problems and solving them, concluding and evaluating. It is also in accordance with the PBL learning model which the center is on students and on the learning process of the PBL model students learn in groups to can get the concept by solving problems. Apart from that, learning no focused on teacher but learning focus on student. Teacher just play a role as facilitator and motivator (Princess et al., 2018). Moment lesson in class model PBL applied and mean so that given experience direct to student so that ability think critical student for find the concept alone. Model PBL considered able to improve students' critical thinking through activities to find and investigate a problem. Based on research data that has been carried out by these two models showing no get the difference.

Difference Ability Think Critical Student Among Student which Have Independence Higher Learning and Independence Low Study

Table 3. Independence study student

Sample class	Sample quantity	Independent learning	Average
Experiment	11	Tall	75.90
	11	Low	73.10
Control	11	Tall	76.40
	11	Low	73.00

Based on the results of the hypothesis analysis, it shows that there is no difference in ability critical critical thinking of students who have high independence with low independence. Influence independence they could see on results analysis test anova 2 track with using *SPSS 26* data obtained that the value of sig> 0.05 means that there is no differences in students' critical thinking, both those who have high independence and those who are independent low. The same also from study (Budiyanto & Euis,2014) that no there is difference independence student learning in both groups learning.

According to the results of the analysis, it is stated that there is no difference in the critical thinking of good students have high and low independence. This is also expressed by (Lumbu'u et al., 2019) said that someone who has learning independence tall possibility have ability think critical good, so also on the contrary somebody which have ability think critical tall can also in have by people who have independence low learning.

Based on the results of the following analysis is a table based on the percentage for each indicator in student learning independence

Table 4. percentage independence study student

No	Independence Indicator	Percentage of learning independence (%)	
		PBL	Conventional
1	Not dependent	20	18
2	Self-confident	15	14
3	Discipline	35	34
4	Responsibility	15	15
5	liveliness	5	5
6	Self-control	11	10

From the table above, it is also clear that there is no significant difference between both learning independence. The research findings confirm that students' independence have role important from process learning. Student which independent have characteristic features such as: self-confidence, character, responsibility, enthusiasm, strategic thinking, discipline, purposeful, creative and not dependent on others (Sandi, 2012). Independence study students already tall when seen there is an increase.

According to (Sugandi, 2013) independent students are students who have the ability to give response to personal, balance position with something certain criteria as well as capable observing also monitoring yourself and also the motivation that is instilled in self. If student have ability think remember tall means student the have strong independence in solving their own problems or tasks for get results which dreamed of. Student which have independence study will trying to regulate their actions and feel they can complete the challenge which are given confidently and diligently and realize all the potential they have within them for dominate knowledge which studied. Very required for develop independence learn in a person to get better work results, can monitor, consistent arrange time, save time and efficient in finishing tasks and definitely get satisfactory results (Harapan, 2017). Student learning independence comes from within each of them that must be honed because each individual has trust and ability individually which later affected to progress.

The Interaction of PBL and Independent Learning of Students on Thinking Ability Critical Student.

Based on the results of the 2-way ANOVA analysis of agar find out if there is an interaction between learning model and independent learning on students' critical thinking that the significance =0.098 > 0.05 means $_0$ accepted $_{and}$ 1 rejected then there is no interaction between use PBL model and student learning independence on students' critical thinking skills. This matter because ability think critical student good which use PBL or learning independence all bring their own impact on students' critical thinking. Student who learn to use the PBL and conventional models both have good averages.

This means that the two models are very effective and both are equally good to be used because in the PBL learning process are: providing problem orientation to students, organizing to students, guidance in student investigations well independently or in teams, develop and present the results of discussions, as well as analyze and evaluated after the problem solving process so that critical thinking skills can be increased (Zunanda & Sinulingga, 2015). In the comparison class that uses the model PBL can also improve students' critical thinking skills and this is because PBL too the process is more student-centred and PBL learning students study in groups so that they can get draft and solve problem with draft new. Besides from that, learning also does not only take place at one point and does not focus on the teacher, but more focus to student. Just a teacher Act as facilitator and motivator (Putri et al., 2018) and these two models are essentially centered on students who are able to make students active. Likewise with student learning independence, based on the results The research explains that students who have low independence have the ability to think Low critical thinking skills as well as having high independence also have good critical thinking skills. From these two things it can be seen that PBL learning models influence each other with student learning

independence.

CONCLUSION

Based on results study and discussion about influence model PBL to think critical student reviewed from independence study student so obtained conclusion that:

There is difference ability think critical student which use PBL with which using conventional.

There is difference think critical student Among student which have independence study tall and that low.

There is the linkages between use model PBL with independence study student to students' critical thinking skills.

SUGGESTION

Teacher should could choose Theory which in accordance when apply Theory Trigonometry

Researcher other which want to use model PBL no need to usemodel variable other.

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