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The students' critical thinking ability through problem posing learning model viewed from the students' curiosity

Fitra Indah Permanawati [a,*], Arief Agoestanto [a], Ary Woro Kurniasih [a]

[a] *Mathematics Department, Faculty of Mathematics and Natural Sciences, UNNES, Indonesia*
D7 Building1st floor, Sekaran Campus, Gunungpati, Semarang 50229

** E-mail address: fitrainda55@gmail.com*

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Abstract

Critical thinking is an embodiment of high-level thinking. The purposes of this research were to find out whether the critical thinking ability of VIII grade of SMP Negeri 1 Wangon on *Problem Posing* had passed the learning completeness grade and it was better than *Direct Instruction* or not, and to describe the students' critical thinking ability through *Problem Posing* seen from the students' curiosity. The results showed that: 1) critical thinking ability of class VIII SMP Negeri 1 Wangon on *Problem Posing* successfully passed the learning completeness grade; 2) critical thinking ability of class VIII SMP Negeri 1 Wangon on *Problem Posing* was better than *Direct Instruction*; 3) the students with high curiosity were able to accomplish 6 indicators, while the students with medium curiosity were able to accomplish 5 indicators, and the students with low curiosity were able to accomplish 3 indicators.

1. Introduction

Education holds a very important role in improving the quality of human resources. Its efforts to embody the ideals of Indonesia has educational purposes contained in Act Number 20 year 2003, national education serves to develop the ability and to form a prestige character and civilization of a nation in the framework of the intellectual life of the nation, aims to develop the potential student in order to be a man of faith and piety to God, has precious character, healthy, bookish, accomplished, creative, independent, and a democratic and accountable citizen.

One of the subjects who needs to give to students is Mathematical subject. It needs to teach to all students from elementary school in order to equip them with the ability of logical, systematical, analytical, critical, and creative thinking, as well as the ability to cooperate. Critical thinking is as a form of thinking ability that must be possessed by students (Kurniasih, 2014). According to Isti (2017), critical thinking ability is an effective way to improve the students' understanding.

Again, according to Ennis (2011:10), critical thinking is reflective thinking that makes sense. It is used to make decisions (Rochmad et al, 2016). Whereas, according to Johnson (2007) as quoted by Kurniati et al (2017), critical thinking allows the students to discover the truth in the medium of a large number of events and information in daily life.

People who have the ideal ability to think critically are the ones who have high curiosity, extensive experiences, full of confident, open-minded, flexible, diligent in searching for relevant information, and make sense in the selection of criteria (Facione, 2000: 65). It is supported by Daniel Perkins and Sarah Tishman as cited by Ormrod (2008: 341), that one of the four criteria of critical thinking is curiosity. Someone who has the ability of critical thinking will be able to examine the problems encountered (Kurniasih, 2012).

Regarding to the preliminary study of the critical thinking ability of students of VIII B SMP Negeri 1 Wangon, it is known that the students' critical thinking ability is still low. It can be seen when students are given contextual question on the circumference and area of circle materials, there are only a few students who are able to resolve the problem properly, while the others are still experiencing difficulty in completing it. Most of the students of class VIII B get problems on the

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indicator to identify/formulate questions, to provide a logical reasoning ability, to give conclusion which is consistent with all the facts, and to identify /control things which are irrelevant.

Based on the results of observation, the low critical thinking ability of students is caused by the lack of students' involvement in learning, especially when the teacher gives students a chance to ask. They only give response by keeping silent. Indeed, one of the abilities of people who have the ability to think critically is able to ask questions and be active in learning (Yohanta, 2011).

Curiosity is the attitude and action that always strive to know more profound and pervasive than anything he has learned, seen, and heard (Kemendiknas, 2011: 24). The benefit of curiosity for students as explained by Kashdan, et al. (2004: 291) is to make students find out something interesting and meaningful, as well as motivating internally. It becomes a bridge for them to acquire knowledge. In addition, it greatly affects to improve their ways of thinking in different terms (Chonstantika, 2013). Curiosity is served as a source of motivation to learn, explore, develop a set of knowledge and skill (Baruch, 2016:2).

Further, based on the results of observation in class VIII B SMP Negeri 1 Wangon using Scool based Curriculum (KTSP) on the subjects of math, the learning applied by mathematics teacher is *Direct Instruction* in which any information is centered on the teacher. On the learning process using *Direct Instruction*, the teacher is more active to explain and convey the material while the students are less actively involved in learning, students only follow the instruction from the teacher. Of course, it causes a lack of curiosity in students and the lack of some aspects of the critical thinking ability of students in solving problems. Thus, it is highly needed to use another learning model which is expected to raise students' curiosity and critical thinking ability.

Critical thinking is an embodiment of higher-order thinking. One of the methods to assess higher-order math skills is through *Problem Posing* (Mahmudi, 2011). According to Wulandari (2017), *Problem Posing* is a study in which students are asked to pose problems based on a particular situation.

Additionally, asking a question or problem by the students themselves are more potential to be better in understanding the learning material than when students are asked by the teachers (Brown & Walter, 2005:166). The activity of proposing problems is able to reduce the anxiety of the students and even motivate students who are less master the topics to try to think critically (Akay and Boz, 2010). As Husni (2014) argues that *Problem Posing* is considered to increase students' curiosity.

According to Stoyanoca and Ellerton (Rahman, 2017), *Problem Posing* is defined as the process in which students build interpretation toward the real situation and formulate it as a meaningful math problem based on their mathematical experience. It not only motivate students to find the correct answer but also motivate them in following every stage in solving problems (Lestari et al, 2017). It also gives emphasis on the formulation of a problem which can develop students' critical thinking ability.

Regarding to explanation above, the purposes of this research are (1) to find out whether the critical thinking ability of students of VIII grade of SMP Negeri 1 Wangon using *Problem Posing* learning model reaches the learning completeness grade; (2) to find out whether the critical thinking ability of VIII grade students of SMP Negeri 1 Wangon using *Problem Posing* is better than *Direct Instruction* learning model; (3) to describe students' critical thinking ability in *Problem Posing* learning model seen from the students' curiosity.

2. Research methods

This research used *mixed method* by combining quantitative and qualitative methods. Quantitative research was begun by determining the population and selecting the samples of the population. The selection of samples was carried out by *random sampling* techniques. The population in the research were VIII grade students of SMP Negeri 1 Wangon of academic year 2017/2018. The selected samples in this research were VIII B students as the experimental class and VIII A students as the control class. For the qualitative research, the subject selection was performed by using *purposive sampling* technique that was by doing certain considerations. The subjects were chosen from experimental class based on the student's level of curiosity namely high, medium, and low. Each of them consisted of 3 subjects which were then analyzed their critical thinking ability.

Then, the measurement of students' critical thinking ability used test method, while to find out the students' curiosity used questionnaire method. The data source of this research were the answer

sheets of critical thinking ability test, the questionnaire of the students' curiosity, and the result of students' interview.

The analysis performed includes the test device and research data analysis. For more, the questions of critical thinking ability used for final test were as follows: (1) determining the facts, (2) identifying/formulating questions, (3) being able to provide a logical thinking, (4) answering question "why", (5) presenting conclusions; students were able to describe/help explain the facts, (6) being consistent with all of the facts, (7) identifying/controlling things which were irrelevant, (8) accepting or rejecting decision. Those questions had been tested through critical thinking ability indicators.

The data of the test result were then analyzed. The analysis of the questions included the validity and reliability tests. Once analyzed, from 2 questions, it was turned out that both of them were worthy to use for final test, then the results of this analysis were then validated by the expert that was the lecturer at the Mathematics department. The questionnaire of the students' curiosity used for the experimental class was the questionnaire of the students' curiosity which had been tested. The data of the test were analyzed by using validity and reliability test. After that, 66 items tested were turned out to be all valid and reliable. Again, the results of the analysis were then validated by the experts that was the lecturer at the Mathematics department and counseling teacher.

Above all, before the research was implemented, the researchers conducted normality, homogeneity, and similarity of two average tests on the final test result data. After students performed the final test, the data were tested by using normality, homogeneity, learning completeness grade, and the average difference test. The results of the students' curiosity questionnaire were then analyzed to classify them into high, medium, and low. Qualitative data analysis was done by the data reduction, data presentation, conclusion, and data verification. In data reduction, the data obtained were summarized and focused upon the ability of critical thinking that has high, medium, and low curiosity. In the data presentation, the data presented were the analysis of students' critical thinking ability in the form of descriptions and presented in the form of a table. In conclusion and data verification, the data were taken from the results of the reduction and the presentation of data on critical thinking ability based on the student's curiosity.

3. Results and Discussions

Based on the normality test with Chi- Square with a real level of 5% of the scores of critical thinking ability test result in class with *Problem Posing* is Gaussian (normal distribution). Based on the homogeneity using the F test with level 5%, the variance of the test score for class with *Problem Posing* is equal to the variance of the test score for class with *Direct Instruction.*

3.1. Results and Discussions of Quantitative Research

The students from the experimental class or control class did the final test of critical thinking ability and retrieved the data of the final test scores on critical thinking ability for both classes presented on table 1.

Table 1. The Data of the Final Test Score on Critical Thinking Ability

Class	N	Average	Standard Deviation
Experimental	36	81,50	5,53
Control	36	70,25	6,59

The data of the final test score on critical thinking ability were then analyzed quantitatively.

The results of the students test scores of Competency-based Curriculum (KBK) on *Problem Posing* class, the lowest score is 70, and the highest score is 92, while the Minimum Criteria of Mastery Learning (KKM) is 75. The number of students who passed the minimum score is 34 students. The first hypothesis is to find out whether critical thinking ability using *Problem Posing* reaches the learning mastery grade, thus the statistical tests used to test is the right party average and the proportion test. From the calculation, the result is t_{cal} = 7.05 and t_{table} = 1.689 so that $t_{\text{cal}} > t_{\text{table}}$ then H_0 is rejected. It means that the average test score of students' critical thinking ability using Problem Posing exceeds the Minimum Criteria of Mastery Learning (KKM). Based on the proportion of test, it is obtained that z_{cal} = 2.78 and z_{table} = 1.64 so that $z_{\text{cal}} > z_{table}$ then H_0 is rejected. It means that the proportion of the students who passed the learning is more than 75% of all students in the experimental class. In other words, the class which uses *Problem Posing* has reached the learning completeness grade.

It is in line with the research of Anwar (2018:6). It reports that *Problem Posing* learning

model reaches the learning completeness grade. In addition, this result is in line with Kholifah's (2018: 916) research, that *Problem Posing* reaches the learning mastery grade both individually and classically.

The second hypothesis is to find out that *Problem Posing* is better than *Direct Instruction* learning model. This hypothesis is tested by using two average difference (right party) and proportion test (right party). On the two average test, it is obtained $t_{cal} = 7{,}90$ and $t_{table} = 1{,}67$ so that $t_{cal} > t_{table}$ then H_0 is rejected. It means that the average score of the final test on students' critical thinking ability using *Problem Posing* is more than *Direct Instruction* learning model. It is similar to the results of the two proportions test. In this research, it is obtained that $z_{cal} = 8{,}68$ and $z_{table} = 1{,}64$ so that $z_{cal} > z_{table}$ then H_0 is rejected.

Based on the two average difference test and the proportion test above, it can be concluded that learning by using *Problem Posing* is better than using *Direct Instruction* learning model. It is in line with the research conducted by Guntara (2014), that the group of students who are learning with *Problem Posing* is better than by using *Direct Instruction* learning model. In addition, these results are also consistent with Juano's research (2016), that the critical thinking ability using *Problem Posing* is better than using *Direct Instruction*.

3.2. Results and discussion of qualitative research

The qualitative data analysis in this research was conducted by data reduction, the presentation of data, and the withdrawal of the conclusions in advance. The data reduction was begun by correcting the final test results, correcting the scale of curiosity questionnaire, and determining the subject that would be interviewed. While the data reduction was done through the observation and interview the research subject by simplifying both of the results became the simple and neat order of the language choices about critical thinking ability.

The scale of curiosity questionnaire consists of 66 questions which have been validated by the experts. Based on the analysis results of the curiosity of 36 students of class VIII B SMP Negeri 1 Wangon scale, there were 17 students of high curiosity, 12 students of medium curiosity and 7 students of low curiosity. The research subjects were selected of each two students in every level of curiosity. Interviews were also conducted to find out the character of the students' curiosity deeply. Further, the indicators of critical thinking ability include: (1) determining the facts, (2) identifying/formulating questions, (3) being able to provide logical thinking; (4) answering question "why", (5) presenting conclusion; students describe/help explain the facts, (6) being consistent with all of the facts, (7) identifying/controlling things that aren't relevant; (8) accepting or rejecting decision. In addition, the interview method was done with the main objective in order to strengthen the indicators against the results of the tests and to investigate the critical thinking ability of students deeper. The subject chosen was later interviewed and analyzed. Based on the analysis of curiosity scale results, there are six selected subjects which are presented table 2.

Table 2. The Subject of the Research

No	Subject	Code	Category
1	S-1	E-04	High
2	S-2	E-10	High
3	S-3	E-11	Medium
4	S-4	E-35	Medium
5	S-5	E-08	Low
6	S-6	E-20	Low

This section discusses the description of the students' critical thinking ability seen from students' curiosity. The curiosity of VIII B students is divided into 3 categories i.e., high, medium, and low. The analysis result of students' critical thinking ability in terms of curiosity is presented in table 3.

Table 3. The results of the analysis of students' critical thinking ability in terms of Curiosity of the students

Curiosity	Indicator							
	1	2	3	4	5	6	7	8
High	Capable	Capable	Capable	Capable	Capable	Capable	Incapable	Incapable
Medium	Capable	Capable	Capable	Capable	Capable	Incapable	Incapable	Incapable
Low	Capable	Capable	Incapable	Capable	Incapable	Incapable	Incapable	Incapable

Description

Indicator 1 determining the facts

Indicator 2 identifying/formulating questions

Indicator 3 Being able to provide a logical thinking

Indicator 4 answering question "why"

Indicator 5 presenting conclusions; students describe/help explain the facts

Indicator 6 being consistent with all of the facts

Indicator 7 identifying/controlling things that aren't relevant

Indicator 8 accepting or rejecting decision

Based on the data analysis of the students' critical thinking ability, it is obtained that the subjects with high, medium and low curiosity were able to answer the question on the indicators **determining the facts**. Forasmuch as they had been accustomed to answering the question in which there were instructions about the indicators, where the instructions intended were to gather information in the question. This occurred because in *direct instruction* learning (before given a treatment), students have often trained in collecting information, so the students easily answer the questions contained **determining the facts** indicator. This is in accordance with the theory of Thorndike about *the law of exercise* that declares that the more a behavior is trained then it will be the stronger and the more familiar (Qurotuh, 2012). In this case, the students' critical thinking ability in determining the facts indicator was increasingly strong and familiar.

Either *direct instruction* or *problem posing* learning model, performed the process of collecting the information. It was repeatedly conducted at each meeting during learning using *problem posing*. In line with the facts, Larasati (2018) states that a job which is done repeatedly, then the work which is initially hard to do will be easier to work on. Thus, it causes the students being able to work on the question of **determining the facts** indicator. This is in line with the opinion of Ariyani (2014), that the conditioning begins from the obligations which are daily performed in which from the things that must be done by the students, then the students will be gradually able to do it. In this case, from the conditioning of students answering question of critical thinking ability in determining the facts indicator, then the students will be gradually able to answer the question of critical thinking ability indicator.

Then, the subjects of high and low curiosity were capable in answering the question on the indicator of **identifying or formulating questions** since they were already accustomed to answering the question in which there were instructions about the indicator. The instructions intended was done to formulate questions by using their own language. This conditioning occurred because, during *direct instruction* (before given the treatment) and *problem posing* learning model, it experienced the process of formulating problem which was done repeatedly on the stage of discussing the issues and the alternative issues. This is in line with theories of Thorndike as cited by Allen (2007) that a process of extensive repetition of activity is aimed to master a skill or technique. The process of answering question which is done repeatedly causes conditioning. As Montana et al., (2013) explain that a process of creating behavior which is repeated until being independent, is conditioning. Eventually, conditioning which is done in answering question caused the students can answer question of **identifying or formulating questions** indicator as in line with Thorndike theory about the law of exercise.

The subjects with high and medium curiosity were able to answer the question of giving a logical reasoning indicator. The subjects were able

to work on the question of **providing a logical thinking** indicator since they were already familiar with the procedures used. It means that they could explain the steps of activities performed, which include the rules of algorithm or the correct counting process to answer the question of **providing a logical thinking indicator**. Kesumawati (2008) adds that if the students do so, they obviously understand the procedure.

While the subjects with low curiosity were less able to answer the question of **providing logical thinking** and **determining the facts** indicator since their calculation to answer question number 1 was incorrect. They were supposed to calculate the height of upright side first, in fact, they directly inserted into the formula. It is in accordance with Supriyanto's and Purwaningsih's (2011) opinion that there are some errors in answering question that is error in understanding the problem and concepts, calculation, and in using the characteristics of the calculating operation. Forasmuch as they do not answer the question of providing a logical thinking indicator the error in calculating occurs.

On **answering the question "why"** indicator, subjects with high, medium, and low curiosity were able to answer the question of the indicator since they were already accustomed to giving the reasons of their answers. This occurred because in *direct instruction* learning (before the given treatment) and during learning model of *problem posing*, students were intended to do so. According to Pugale as quoted by Rahmawati (2013), students need to give arguments about the answer given in learning continuously and provide comments on the answers given by others. Again, as Pugale which is quoted by Abimayu et al (2015) explains that it is urgently necessary for conditioning to give response to the answer given by others in mathematics learning so that the things learned by students become more meaningful. The conditioning gives the reason for the answer given on this indicator.

The subjects with high and medium curiosity were able to answer the question of **presenting conclusion; students describe/help explain the facts** indicator. While on the subjects with low curiosity were less able to complete the indicator, because their calculation on number 1 was incorrect since they did not calculate the surface area twice and thrice more correctly, consequently, they could not provide the right conclusions and answers. In addition, they had not mastered the mathematical ability well, so they could not solve the math problems on **presenting conclusion; students describe/help explain the facts** indicator. It is in accordance with Widiharto's (2008) statement as cited by Abdullah (2015) that mistakes and difficulties are caused by the mathematical capabilities which are not fully mastered by the students which cause mistakes in solving math problems.

The subject with high curiosity was able to work on the question of **being consistent with all the fact** indicator. While on the subjects with medium and low curiosity were less able to answer the question of this indicator since they were unable to implement the new formula which already obtained in the previous question as they were not thorough in reading the commands of the question. As White (2012) states that there are 5 types of Newman error in resolving the problem namely (1) error reading, (2) error understanding, (3) error transformation, (4) error process capabilities, and (5) error coding. In this case, error reading the command in question led the students got difficulties in solving math problems on **being consistent with all facts** indicator. As supported by Bell (1981) as cited by Rumasoreng & Sugiman (2014) that the error reading in mathematical problems causes difficulties in solving math problems.

The subject of high, medium, and low curiosity were less able to work on the question of **identifying/controlling things that are not relevant** indicator since they had a misconception. As of Ozkan & Ozkan (2012) say that a repeat error in assuming a concept is a misconception. The misconception occurred when they should calculate the height of the upright side and produce calculations = $\sqrt{1.36}$, but they directly input the data into the formula. Additionally, they did not really master the implementation of algorithm or a strategy appropriately. This is in accordance with the statement Woodward, Baxter, & Howard (1994) as quoted by Ojose (2015:33) that misconception occurred because the shallow and sustainable understanding of mathematics enable students to apply the algorithms or strategies incorrectly. In the end, it inhibits the development of students' critical thinking ability, so they could not correctly answer the problem of this indicator. Rochmad et al (2018), say that the misconception inhibits students in fostering critical thinking.

The last indicator, the subject of high, medium, and low curiosity were less able to work on the question of **accepting or rejecting decision** indicator since their calculation was incorrect. It

occurred because of a mistake in understanding the problem. In accordance with the statement of Supriyanto and Purwaningsih (2011), that there are some errors in understanding the question, one of them is an error in calculation. Further, it causes students to be less thorough. As Farida (2015) explains that the error in calculation is caused by less careful in calculating. Eventually, their answer on **accepting or rejecting decision** indicator was inappropriate. Hidayat (2012) supports that less careful in complementing the answers leads to inappropriate answers.

4. Conclusions

Based on the previous explanation, there are several conclusion which can be drawn, as follows:
1. The students' critical thinking ability using *problem posing* learning model reaches the learning completeness grade.

2. The critical thinking ability of students in *problem posing* class is better than those in *direct instruction* class.

3. The description of students' critical thinking ability through of problem posing learning model is reviewed from the students' curiosity are: a) the sbujects with all levels of curiosity are able to answer the question of determining the facts and identifying/formulating questions indicator but less able in identifying/controlling things that aren't relevant and accepting or rejecting the decision indicator; b) the subjects with high and medium curiosity are able to answer the question of providing a logical thinking, answering the question "why" and presenting conclusion; students describe/help explain the facts indicator. However the subjects with low curiosity are less able in answering the questions of those indicators; c) The subjects with high curiosity are able to answer the question of being consistent with all facts indicator, whereas the subjects with medium and low curiosity are less able to answer the question of this indicator.

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