

Mathematics Critical Thinking Ability Based on Student's Cognitive Style in Whole Brain Teaching in Ethnomathematics

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Abstract

This research is aimed to (1) investigate the effectiveness of student learning in the application of the Whole Brain Teaching in ethnomathematic in improving mathematics critical thinking ability, and (2) explain the mathematics critical thinking ability in the application of Whole Brain Teaching in ethnomathematic in terms of student's cognitive style. Mixed method with sequential explanatory was applied in this research. Critical Thinking Ability Test, observation, and interview were employed in obtaining the data. Selection of research subjects were according to cognitive by using GEFT. The data analysis appeared to prove that (1) WBT learning model in ethnomathematic effective to the achievement of student's mathematics critical thinking ability, and (2) the achievement of student's mathematics critical thinking ability of FD were capable and fluent in three indicators, FIL student capable and fulfill four indicators, and FIK student capable and fulfill all the indicators. Based on this research, the WBT model in ethnomathematic can be choice to improve student's learning outcomes, particularly the mathematics critical thinking ability. Student interest in local culture will facilitate the understanding of the learning material.

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INTRODUCTION

Human life's aspects developing as the growth of science and technology rapidly fast. However, the use of technology must be balanced with the human mindset in order to provide benefits. Human mindset can be formed by mathematics. Math can equip students with logical thinking, analytical, systematic, critical, creative, innovative, and independent (Khuzaeva, 2014).

One of the goals of mathematics in Permendikbud No. 21, 2016 is showing a critical attitude. Critical thinking is something that must continue to be developed, because critical thinking is the essence and role as the realm of competence in mathematics learning process. Mathematics critical thinking is mental activity in mathematics using the steps in the scientific method, that is: understand and define problems, collect and analyze the necessary information and trustworthy, formulate presumptions and hypotheses, testing hypotheses logically, carefully conclude, evaluate and decide on something that will be believed or something will be done, and predict the possible consequences (Abdullah, 2013), Mathematics critical thinking is the ability and disposition to incorporate prior knowledge, mathematical reasoning, and cognitive strategy to generalize, prove, or to reflectively evaluate the odd mathematical situation.

Fascione (2015) extend that critical thinking is a full consideration ability to display the show self regulation in considerate reasoning suggests on proving, context, standards, methods, and conceptual structure for making decisions or what to do. Self-regulation is also give an impact on detailed solving questions. Students with high mathematics critical thinking ability in Interpretation, analysis, evaluation, and problem solving clear, complete, and more detail solved. (Abdurrohman and Djuniadi 2016),

Cognitive style has been widely studied by an experts, including Woolfolk (1993) suggested that cognitive styles are students different ways how understand and organize information. Each individual, will never be separated from the influence of cognitive styles when examining information. According to Jonassen & Grabowski (1993), as cited by Ghinea & Chen (2006: 190-192) based on

differences in psychology there are two kinds of cognitive style that is Field Dependent (FD) and Field Independent (FI). FD is the type of individual people who think globally and tend to be passive, while individual FI is the type of individuals whose analytically understand and process the information (Prabawa, 2017). Each individual has a different background in cognitive styles, so that information processing will also highly varied according to their cognitive style. This research try to classify problem solving ability of students in according to the type of cognitive style.

Learning model which explore the potential of student's brains are learning model which is based on the theory of the brain. One theory that discusses the brain works is the Whole Brain Theory, the theory distinguishes the structure of knowledge in student's brain into 4 types based on the focus of each piece. According Bawaneh (2011) HWBT method has four stages of learning which aims to accommodate each part of the brain of the student according to the Whole Brain Theory. Whole Brain Teaching is a combination of direct learning model cooperative learning and student-centered (Biffle, 2014).

WBT is the preferred model of learning that students and served as an indication of cognitive, emotional, and psychological (Khalid et al. 2012),

Ethnomathematic can be used for more meaningful learning activity. Ethnomathematic experts found that the development of mathematics basically forever inseparable from the culture and values that already exist in the community (Zaenuri, 2018). The environment can be used as an helping hand in understanding of the student's mathematics learning (Pujianto, 2016). Ethnomathematic is the study of mathematics culture consideration which mathematics appear to understand the reasoning the mathematical systems they use. Ethnomathematic is mathematics which is practiced among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain codes and jargons which do not belong to the realm of academic mathematics (D'Ambrosio, 1985).(François 2010),

The goal of this research focused on the study of (1) effectiveness of student's learning in the application of the Whole Brain Teaching in ethnomathematic in

improving mathematics critical thinking ability, (2) review of mathematics critical thinking ability based on student's cognitive style.

METHOD

This study using the Mixed Method with sequential explanatory. Mixed method is a research method that combines quantitative and qualitative methods to be used together in a research activity, in order to obtain more comprehensive data, valid, reliable, and objective (Sugiyono, 2015: 404). Sequential explanatory or research strategy with the order of proof is a combination of research strategies that prioritize the data quantitative rather than qualitative data (Creswell, 2013). The population is a class XII students at SMAN 2 Grabag Magelang odd semester of 2018/2019 academic year. Random cluster sampling technique used in this research which is randomly selected two classes of the population, that is the experimental class and control class.

Data collection techniques will include questionnaires, validation of learning tools, test observations, and interviews.

This study consisted of two phases: pre-field and field work. In the pre-stage field researchers set up research equipment, among others syllabus, lesson plan (RPP), sheets Group Embedded Test Figured GEFT, local culture questionnaire, interview and Mathematics Critical Thinking Ability Test. All research equipment in consultation with the supervisor and special for Mathematics Critical Thinking Ability Test were tested first.

At this stage of field work begins with provide local culture questionnaire and did GEFT for the experimental class. Each group cognitive selected two students to mathematics critical thinking ability analyzed in depth. Furthermore, researchers conducted two times learning the linear program material using *Whole brain teaching* model in ethnomathematic.

This study using quantitative and qualitative data analysis. Quantitative data analysis consisted of normality test, homogeneity test, a test for classical completeness, test for equality of two average one hand, and the comparative test one sample pairs.

While quantitative data analysis is done by reducing the data, presented data, and making inferences.

RESULTS AND DISCUSSION

Whole Brain Teaching learning effectiveness in ethnomathematic in improving mathematics critical thinking ability

The results of the final test analysis showed that the final data in the experimental class and the control class has a normal distribution and homogeneous variance. Based on the research were (1) using classical completeness test, the value $z_{count} = 2,417 > 1,96 = z_{table}$, then 75% of students in the class whole brain teaching in ethnomathematic classically complete, (2) using an average different test, the value $t_{count} = 6,28 > 1,99 = t_{table}$, then the student's mathematics critical thinking ability taught by whole brain teaching models in ethnomathematic better than the student's mathematics critical thinking ability taught by scientific discussion.

Based on these results can be concluded that the whole brain teaching model in ethnomathematic effectively upgrade the student's mathematics critical thinking ability. The results are consistent with research-Torio Torio and Cabrillas (2016) in the Philippines stated that the use of WBT as a learning strategy found effective influence on academic achievement and motivation.

In comparative tests of paired samples obtained values $sig. = 0.007 < 0.05$, that will be rejected H_0 , which means the average of local culture interest taught by Whole Brain Teaching in ethnomathematic better than before learning.

Improvement local culture interest seen by the local culture interest character building process on the four subjects have been specified. The observation of the four subjects showed an increase in the attitude of selected participants to the culture. Before attending study in ethnomathematic Whole Brain Teaching, students did not know and did not interested in the culture of Magelang. Student's attitudes toward culture became better after participating in Whole Brain Teaching learning in ethnomathematic.

Description of Mathematics Critical Thinking Ability

Based on the results of research, student's mathematics critical thinking ability of in terms of cognitive are vary. Students are divided into groups of Weak Field Dependent (FDL), Strong Field

Dependent (FDK), Weak Field Independent (FIL), and Strong Field Independent (FIK).

The results work of the FDL subject could be seen in Figure 1.

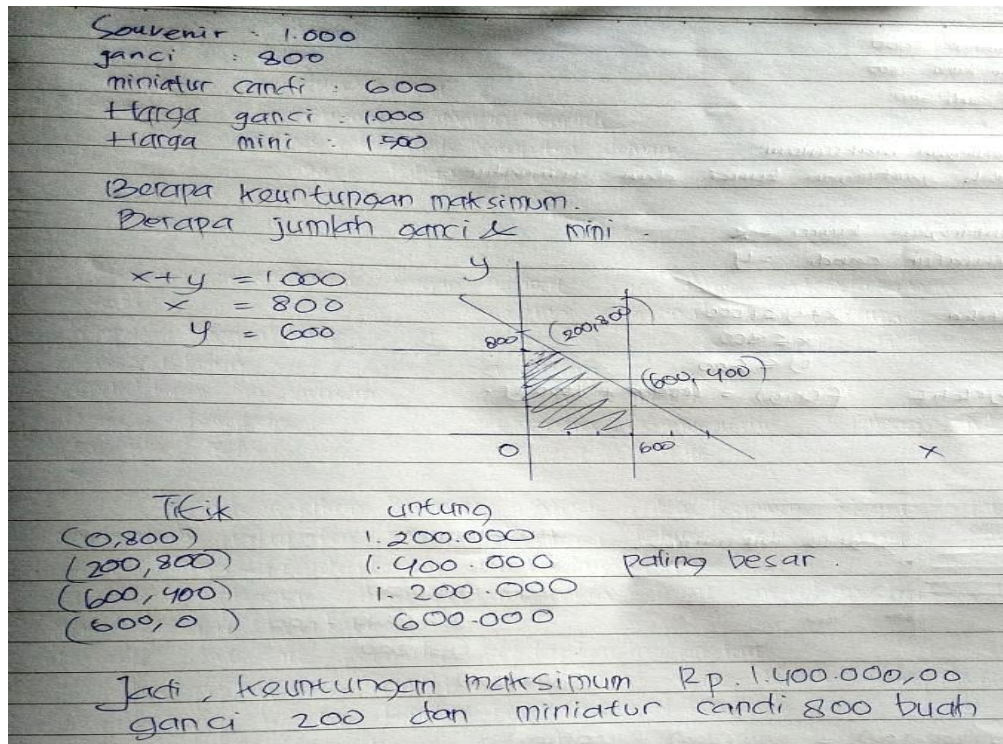


Figure 1. FDL subject's Work

Achievement of FDL subject's mathematics critical thinking ability could be seen in Table 1.

Table 1. FDL Subject's Mathematics Critical Thinking Ability

Indicator	subject FDL
Interpretation	Capable to explain clearly the problems that exist in the matter. Information from such written about what has been taught in the classroom.
Analysis	Capable of connecting data and information.
Inference	Being able to resolve the problem with the memorized mathematic formula.
Evaluation	Less capable to test the truth. The formula recited by the lack of understanding makes testing the truth becomes less.
Explanation	Less able to present the results. It is associated with less testing truth.
Self Regulation	Not Able to self-understanding.

FDL subject controls three of the six indicators, two indicators in the underprivileged level, and one indicator in the inadequacy levels. Interpretation, analysis, and evaluation indicator in the levels capable. The subject is able to explain and give data meaning. FDL subject understanding to the existing problems in the matter was quite high. Basically interpretation is easily found that the subject explained it clearly. The subject's ability to connect data and information was quite good. Subject fixed errors by finding the right data. FDL subject was able to test the correctness of the data. However, less able to solve the problems. Understanding of the formula is pretty good, but there was an error when entering the model into the

equation. The ability of the subject FDL explanation as well as the ability of inference, there are a few mistakes when presenting the results. Subject is not skilled in the self-understanding of the end taken result. FDL subject wrote the steps as the teacher taught in the classroom. However, some errors are still found.

Results work of FDK subject could be seen in figure 2.

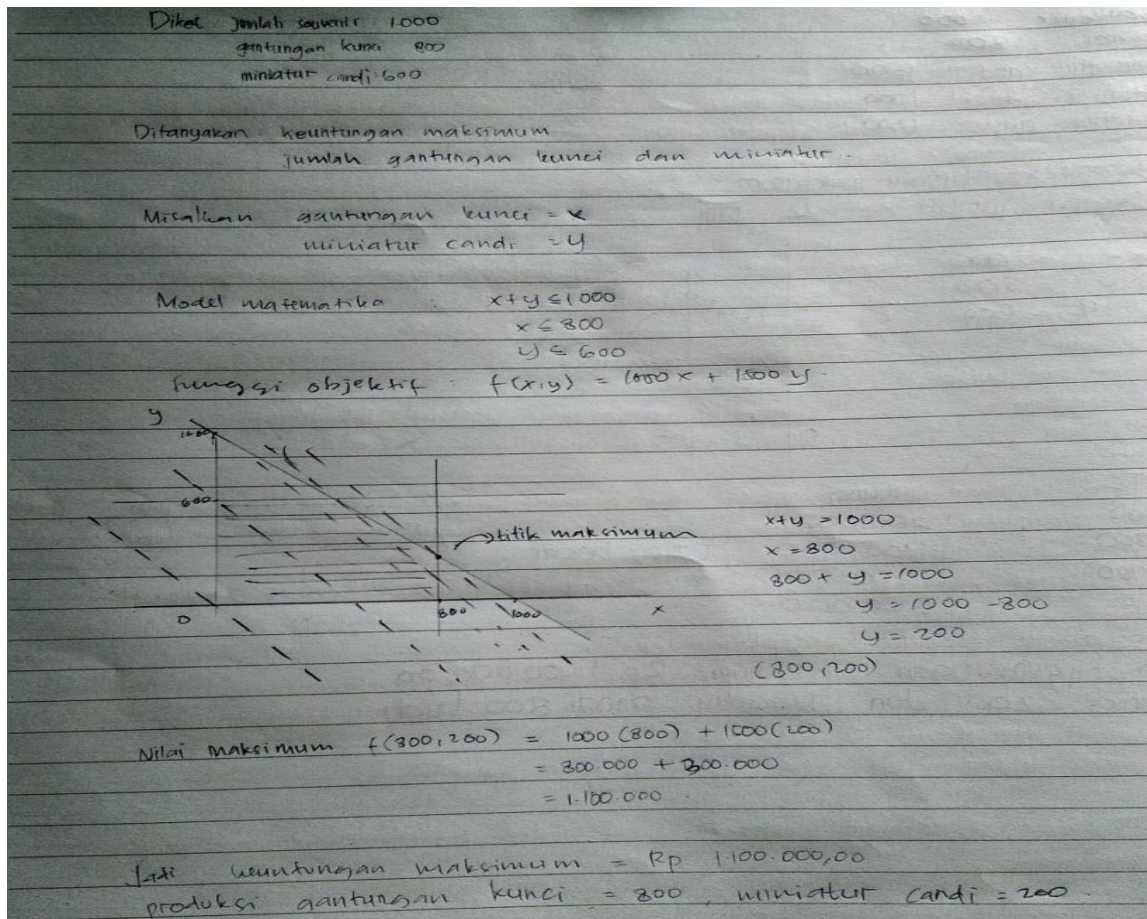


Figure 2. FDK Subject's Work

Mathematics critical thinking ability of FDK subject could be seen in Table 2.

Table 2. FDK Subject's Mathematics Critical Thinking Ability

Indicator	FDK Subject
Interpretation	Capable to clearly explain the problems that exist in the exact problem solving was taught in class.
Analysis	Capable of connecting data and information. Nimble in finding a connecting between information and problem.
Inference	Capable to solve the problem. A quick understanding of the problem makes it easy to solve.
Evaluation	Less Able to test the truth. Although the problem solved well, there are doubts when conducting the evaluation.
Explanation	Less able to provide the results even though the data was correct.
Self Regulation	Underprivileged in self-understanding.

FDK subject capable in three of the six indicators of mathematics critical thinking and the other three levels are less capable. Capable to interpret the subject matter to understand the problem, explanation, and give data meaning. Pretty good capability in analysis was indicated by the information of matter that is able to be clearly connected. Subject's evaluation ability shown with the validity test ability of the data and obviously did it. Generally the subject understood the problem solving, the inference ability still less, shown at the errors existences in solve determining. The subject's algebra ability was good,

but a mistake on problem solving explanation makes it less skilled in the end result. Generally, the progress was made as well as being taught, as well as answers to the interview. FDK subject tends to replicate exactly what is taught in the classroom. As the Davis's review from social interaction and stated that the FD is an extroverts individual type, have the external motivation, and easily influenced by group (Khatib, 2011: 641).

FIL subject's work results could be seen in figure 3.

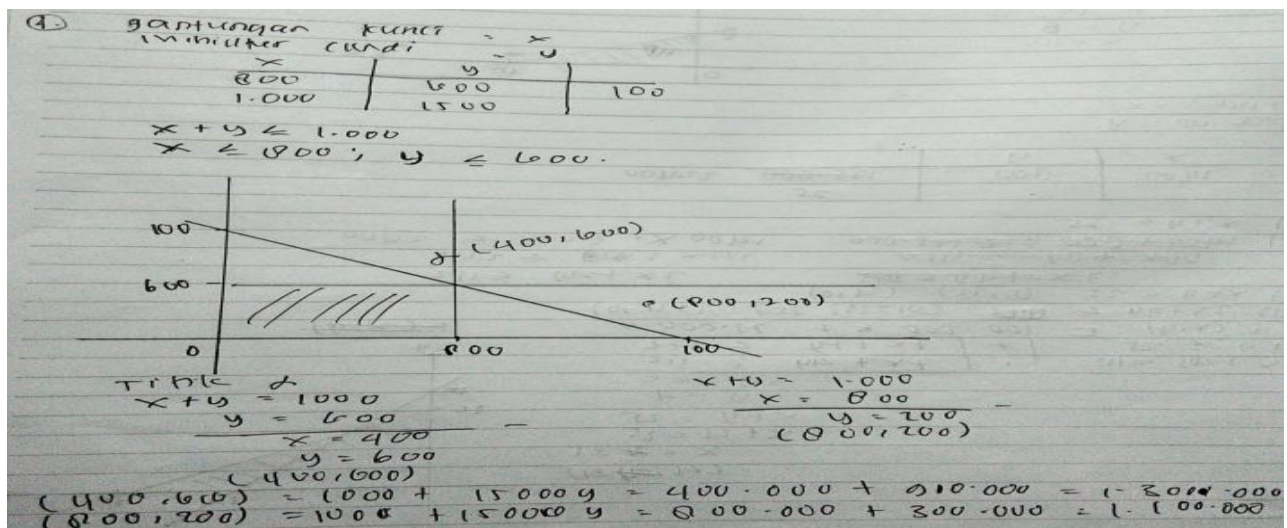


Figure 3. FIL Subject's Work

FIL subject's mathematics critical thinking ability could be seen in Table 3.

Table 3. FIL Subject's Mathematicas Critical Thinking Ability

Indicator	subject FIL
Interpretation	Capable to clearly explain the problems that exist in the matter and the reasons.
Analysis	Skillfully connecting data and information.
Inference	Capable to resolve the issue in question and have another solving way, but it is merely an idea. The solution wrote the same as taught by the subject.
Evaluation	Capable to test the truth.
Explanation	Less able to present the results.
Self Regulation	Underprivileged in self-understanding.

FIL subject experts on four of six indicators of mathematics critical thinking ability and two on underprivileged level. Subjects were able to interpret the problem is shown with a good understanding. Data associated with both capable of analysis implies that the subject matter. FIL subject could verify the

information, which means that the subject was able evaluation. FIL subject expressed a desire to write down the steps and different ways to teach, but do not trust himself to write in the answer sheet.

FIK subject work could be seen in Figure 4.

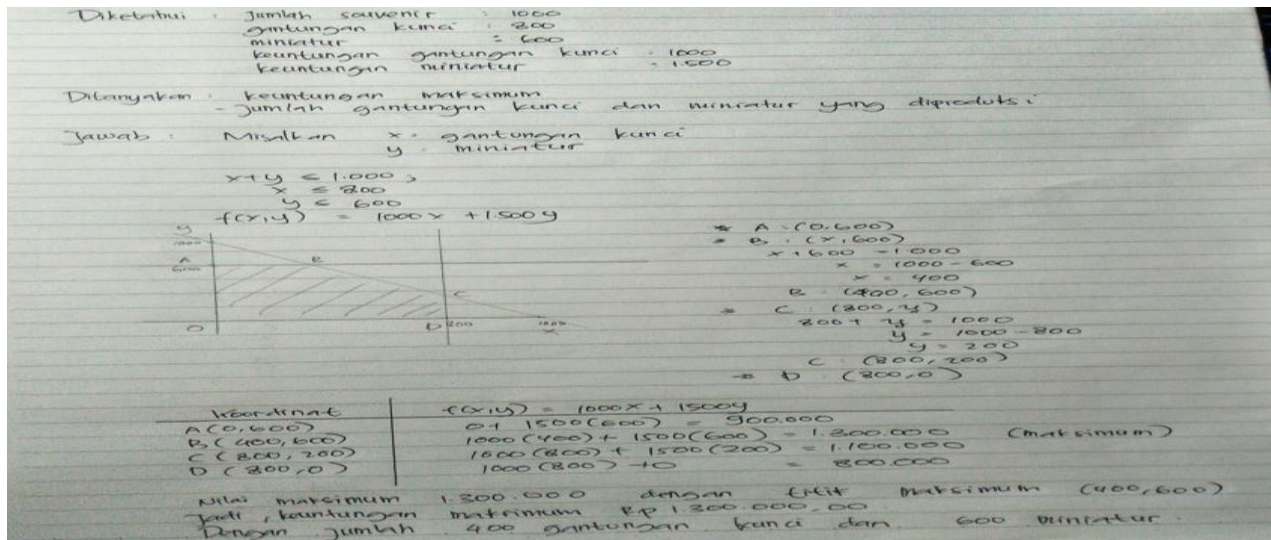


Figure 4. FIK Subject Work

FIK subject's mathematics critical thinking ability could be seen in Table 4.

Table 4. FIK Subject's Mathematics Critical Thinking Ability

Indicator	subject Nikken
Interpretation	Capable to clearly explain the problems that exist in the matter along with other ideas held.
Analysis	Capable of appropriately connecting data and information.
Inference	Capable to solve problems and write down other ways that have not been taught in the classroom.
Evaluation	Capable to test the truth carefully because the understanding of problem solving is quite high.
Explanation	Being able to present the results.
Self Regulation	Capable of self-understanding.

FIK subject expert in all the indicators of critical thinking. This indicates that the subject did not find problems in working on. The matter situation can be understood by the subject. Likewise with the existing procedures, can be properly controlled. Description and relationship data can be analyzed making it easy to identify problem resolution in the matter. Subjects were able to calculate the results of inference. The explanation given was very straightforward and had an idea solving problems in ways that made by subject itself. Geni (2017) reveals that the subject of independent field category is able to understand the problem properly, the subject can completely and correctly write the known elements of the problem.

CONCLUSION

Based on the results of research and discussion could be concluded (1) Whole Brain Teaching model learning in ethnomathematic is effective and, (2) mathematics critical thinking ability of each group, from of six indicators of mathematics critical thinking, FD students capable and expert in the three indicators, FIL student capable and expert in the four indicators, and FIK student capable and controlled all the indicators. By finding the results of the student's critical thinking ability, WBT model in ethnomathematic can be selected to improve student learning outcomes, particularly the

critical thinking ability of mathematics. Student interest in local culture will facilitate the understanding of the material. It is advisable for educators to determine the cognitive style of students before giving lessons. Further research can be analyzing based on critical thinking ability mathematical indicators according to the type of student's cognitive style.

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