

The Effectiveness of Problem-Based Learning Model Nuances with Ethnomatematics Nuances to Improve the Critical Thinking Ability

Zaenuri
Universitas Negeri Semarang
zaenuri.mipa@mail.unnes.ac.id

Putik Dwindi Hapsari
Universitas Negeri Semarang
putikdwinda@gmail.com

Wardono
Universitas Negeri Semarang
wardono.mat@mail.unnes.ac.id

Yohanes J. Kehi
Universitas Timor
kehijohanes@gmail.com

Suryandaru Prasetyo Jati
Universitas Negeri Semarang
suryandaru15@gmail.com

Abstract---The aim of this research is to analyze the effectiveness of the Problem Based Learning (PBL) model with ethnomatematics in improving students' critical thinking ability. This study applied quantitative type of research. The population was the 4th grade elementary school of Banyumas in 2019. The sample selection was done using random sampling technique. The sample in this study were the fourth grade students of SDN 1 Cikawung and SDN 1 Semedo. The data collection techniques used in this study were tests of critical thinking ability, observation and documentation. The technique of data analysis of quantitative used was proportion test, one sample t-test dan independent t-test. The results of the hypotesis showed that the proportion completeness, the average, and the increasing of critical thinking ability of PBL students with etnomatematics nuanced was better and higher than control classes. The result showed that the PBL model with etnomatematics nuances is effective for improving students' critical thinking ability.

Keywords: PBL, ethnomatematics, critical thinking

I. INTRODUCTION

The era of globalization gives people access to information that is very open and easy to obtain. As well as information about the results of the Trends study in the International Mathematics and Science Study (TIMSS). The results of the TIMMS study provide information that students' critical thinking skills in solving problems are still low. The critical thinking ability of students who are still relatively low is a problem in mathematics. Critical thinking is an important aspect in mathematics learning[1]. Other than that practicing students' critical thinking ability is one of the important ways to improve students' mathematical abilities[2].

Critical thinking ability is one important thing to solve the problem[3]. The critical thinking ability used in the study consisted of four stages, they are: 1) finding problems; 2) collecting data or information; 3) find ways and 4) make conclusions. Once the importance of critical thinking skills, the improvement of critical thinking skills of elementary

school students can be done through the Problem Based Learning (PBL) learning model. PBL is the use of various kinds of intelligence needed to deal with real-world challenges[4]. Intelligence needed is intelligence in solving problems and critical thinking. PBL allows students to develop thinking skills (reasoning, communication and connection) in solving problems [5]. Critical thinking ability is applied to PBL models using real problems that exist in the student environment[6].

Local food has an important role in as local identity, consumption behavior, one of the media to transfer cultural heritage to future generations[7]. Besides, it can be used as a tool for the legacy interaction with the whole world. One of the things that can be done is by introducing the local foods to the elementary students.

The introduction of elementary students with local food can be done by using culture-based learning on mathematical concepts. Culture related to mathematical concepts is called as ethnomatematics[8]. The study was conducted by exploring the flat shape of the local food[9]. Banyumas local food use were mendoan, krupuk ampas tahu, lemet, dage and utri chips with mathematical concepts, such as circumference and flat square figure, for example, rectangle and triangle.

Learning that presents problems regarding local food will create interesting and meaningful learning. Interesting and meaningful learning makes it easier for students to accept, process and develop critical thinking skills so they can solve problems in the right way and at an efficient time. The more ethnomatematic-based learning is applied, the easier it will be for students to apply mathematical concepts to problems in everyday life [10].

Based on the above description, this study was intended to analyze the effectiveness of the application of the problem-based learning model (PBL) through the local culture of Banyumas Regency to improve the critical thinking ability of

the elementary school students. The critical thinking ability will be used in the material of mathematics subjects and flat figures of a square, rectangular and triangular in elementary schools.

The effectiveness of the PBL model with ethnomatematis was measured by the achievement of learning objectives, such as the improvement of the students' critical thinking ability. Achievement of learning objectives is said to be effective if (1) the average value of students' critical thinking ability in the learning using PBL models with ethnomatematis nuances is higher than KKM, (2) the proportion of completeness of students' critical thinking abilities with PBL models with ethnomatematis characteristics beyond 75% classical completeness (3) the proportion of students' critical thinking ability in the PBL model with ethnomatematis nuances is better than the control group, (4) the average of critical thinking ability of students in the PBL model with ethnomatematis nuance is better than the control group, (5) the increase of students' critical thinking ability in PBL models with ethnomatematis nuance is higher than the control group..

II. METHODS

This study applied quantitative research methods. The study was conducted in Banyumas. Population of the study were SDN in the area of Widiasarkara. The location and subject of the study was selected by using random sampling obtain result that students of grade IV SDN 1 Cikawung as the experimental group and students of grade IV SDN 1 Semedo as the control group. The stages of the quantitative method were carried out as follows, 1) the preliminary stage, 2) the trial stage and 3) the implementation stage.

In summary, the activities carried out were, 1) exploring the local food in the Banyumas, 2) analyzing the linkages of the local food with the concept of two dimensional figure as a means of learning mathematics in elementary schools, 3) analyzing the learning effectiveness using ethnomatematis PBL models to improve the critical thinking ability of the elementary students.

III. RESULTS AND DISCUSSION

The critical thinking ability applied in this study consists of four stages, namely recognizing problems, collecting data or information, finding solution and making conclusions. The application of critical thinking ability was applied in solving problems around the students, Banyumas local food. Banyumas local foods here including mendoan, krupuk ampas tahu, lemet, dage chips and utri. The following are the results of analysis conducted in the experimental class and the control class.

Table 1 The Result of the Analysis in the Experimental and Control Group

Class	N	Mean	Std. Deviation
Eks	28	82.30	9.805
Cont	28	76.11	9.523

Based on the table 1 The study carried out has succeeded in increasing the critical thinking ability of elementary students in Banyumas through the learning of PBL models with ethnomatematis nuances. The ethnomatematis used is the concept of two dimensional figure such as square, rectangular and triangle flat using Banyumas local food. The following are the results of critical thinking ability that were processed using SPSS software and manually.

The following is the calculation of the results of the pre test and post test. The data was processed using a SPSS application and using manual calculations. The result of the analysis average test can be seen in table 2.

Table 2 Result of the Average test

t	df
6.473	27

Based on the table of one sample t-test, in the column of t obtained a score of 6.473 > 1,70 which means that the average critical thinking ability in the class using the PBL model with loosely based culture ethnographic scores was more than KKM which is at 70.

The classical completeness test of critical thinking ability can be seen in below this.

$$Z = \frac{\frac{x}{n} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}} = \frac{\frac{28}{28} - 0,75}{\sqrt{\frac{0,75(1-0,75)}{28}}} = \frac{1-0,75}{\sqrt{\frac{0,75(0,25)}{28}}}$$

$$Z = \frac{0,25}{0,0066964286} = \frac{0,25}{0,0084704453} = 2,539$$

Based on the calculation done using the formula of z test obtained z count = 2,539. The indicator of H0 is z count ≥ z (0,5 - α). The value of z from the standard normal distribution list is z_(0,45) = 0,3264. Based on the above data, it can be concluded that 2,539 > 0,3264, therefore, the critical thinking ability of the students using the PBL model with ethno mathematics nuances has reached the classical completeness of 75%. The proportional different tes can be seen in below of the formula.

$$\text{Formula} = \frac{\frac{x_1 - x_2}{n_1 - n_2}}{\sqrt{p \cdot q \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} = \frac{\frac{28 - 22}{28 - 28}}{\sqrt{0,3928 \times 0,1072 \left(\frac{1}{28} + \frac{1}{28} \right)}}$$

$$= \frac{\frac{6}{28}}{\sqrt{0,098570 (0,7142)}} = \frac{0,2142}{0,0683} = 3,1361$$

Based on the above calculations obtained the results of calculation z count = 3.1361. The z value from the standard normal distribution list is ztable = 0.4801. It can be concluded that $3.1361 > 0.4801$, the proportion of completeness of critical thinking ability of students using PBL models with ethnographic nuance is better. The result of the analysis of the average different test can be seen in table 3.

Table 3 Result of the Average Different Test

t	df
2.375	53

Based on table 3 regarding the results the average different test, obtained data that the independent table of the *t* column t-test sample is $6,473 > 1,70$. It can be included that the average critical thinking ability of students in the Problem Based Learning learning model with ethnomatetic nuances is better.

The following is a result of the analysis of improvement test of critical thinking ability can be seen in table 4.

Table 4 The Result of the Improvement Test of Critical Thinking Ability

t	df
2.268	54

Based on table 4 regarding the results of the improvement test of critical thinking ability obtained a score of $2,268 > 1,67$. Therefore, it can be indicated that the increase in students' critical thinking ability in the Problem Based Learning learning model with etnomatematics nuance is higher.

Students' critical thinking ability in this study was carried out with four stages of critical thinking. The four stage of critical thinking ability used in material concept and circumference of square, rectangular and triangle with etnomatematics nuanced by using local food of Banyumas. There are five local food of Banyumas that used in this research. Banyumas local food such as *mendoan*, *krupuk ampas tahu*, *lemet*, *dage chips* and *utri*. This is the figure of Banyumas local food.

The first of Banyumas local food is mendoan. Mendoan comes from the word "Mendo" comes from the regional language, Banyumasan, which means half-cooked. Tempe Mendoan is only half cooked fried. The figure of Tempe Mendoan can be seen as follow.



Figure 1. Mendoan

Based on Figure 1 it can be identified that mendoan has a square flat shape. Mendoan can be used as a medium to teach the concept of a wide of two dimensional figure of square.

Mendoan can be used as a medium to teach the concept of wide-area of flat square and help students to find the formula for the area of a square, which is the side x side. The discovery of the concept is based on the results of students' measurement on mendoan using standard measuring instruments such as rulers.

There is no standard size of local food, however, usually the size of the Banyumas mendoan ranges from 8-12 cm. This measure can be used by the teacher to teach the concept of square area.

The second Banyumas local food is *krupuk ampas tahu* means crackers that come from the remaining of tofu. The nutritional content of tofu crackers are protein, fat, water and ash. Below is the figure of *krupuk ampas tahu*.



Figure 2. *Krupuk Ampas Tahu*

Based on figure 2, it can be identified that *krupuk ampas tahu* have a similar shape with two dimensional figure of square. The size of *krupuk ampas tahu* is not standard, however, usually the sides of *krupuk ampas tahu* are 6 cm in size. Through the varied sizes of *krupuk ampas tahu*, tofu dregs crackers can be used as a medium to teach the concept of circumference of flat figure of a square. Through the pulp of tofu, students were helped to better understand where the formula around the square, which is 4 x side is obtained.

The third Banyumas local food is lemet. Lemet is a traditional cake made from cassava which is grated or mashed and then squeezed and taken from the pulp, mixed with brown sugar and then steamed. Below is the figure of lemet.



Figure 3. Lemet

Based on figure 3, it can be identified that lemet has a shape similar to a two dimensional figure of rectangular. Lemet can be used as an alternative for teachers to deliver material on a wide concept of two dimensional figure of rectangular.

The size of the lemet is very varied depending on the size of the banana leaf used to wrap the lemet dough. Variable lemet size can be used by the teacher to help students to find and understand the concept of flat figure of a rectangular that has two different sizes, up to a flat rectangular area, namely length x width.

The fourth Banyumas local food is kripik dage. Kripik dage is a particular food of Banyumas which is still one variant with tempeh, however, there is a mixture of coconut pulp ingredients which called as "dage" by Banyumas people. Below is the figure of dage chips.



Figure 4. Kripik Dage

Based on Figure 4 it can be identified that kripik dage has a shape similar to a two dimensional figure of a rectangular. The side size of *kripik dage* is not always the same. However, usually the width size of *kripik dage* has the same size. This size can be viewed since the kripik dage has a standard print of 4 cm. Meanwhile, the measurement of the length of the side is not always the same since it depends on the cuts made by the maker of krupuk dage. Kripik dage can be used as an alternative for the teacher to convey the material of circumference of flat figure of a rectangle, which is $2 \times (\text{length} + \text{width})$.

The last Banyumas local food is utri. Utri is a flour cake containing brown sugar or banana, often called nagasari cake. The following is the figure of Utri.



Figure 5. Utri

Based on Figure 5, it can be identified that utri has a shape similar to the two dimensional figure of triangle. The size of each side is determined based on the size of the banana leaf that is used as a wrapper for utri dough.

The sides of the *utri* usually range from 8cm to 12cm. Different side dimensions of *utri* can be used as an alternative for the teacher to convey material of width and circumference of the flat figure of a triangle. To find out the extent of *utri*, students only need to look for two sizes, namely the base and height of the utri, while for finding the circumference the student needs to measure the three sides of the utri.

Learning using the PBL model with ethnomatematic nuances is effective for improving the critical thinking ability due to several things including; 1) students in learning using PBL with ethnomatematics nuances are able to obtain more questions and task on worksheets and teaching materials about the width concept and circumference of the square, rectangular and triangular of flat figure associated with Banyumas local culture such as mendoan, kripik ampas tahu, lemet, kripik dage and utri compared to the Discovery Learning-Scientific classes; 2) students in the learning using PBL with etnomatematics nuances were more active in asking questions about the material that is not yet understood, such as the material of flat figures of square, rectangle and triangle that is presented with Banyumas local food culture and asking fellow group friends and teachers compared to Discovery Learning-Scientific classes; 3) students in the learning using PBL with etnomatematics nuances were more active in discussing than students in the Discovery Learning-Scientific class. Therefore, students really understand the mathematical concepts of width and circumference of flat figures of (square, rectangular and triangular) constructs associated with Banyumas local food. The results of this study are in line with the other results that ethnomatematics derived from student environments such as local food can help students integrate mathematical concepts with the local culture so that they have an impact on students' basic mathematical ability[11].

IV. CONCLUSION

Based on the results and discussion presented, PBL learning model with ethnomatematic nuances using traditional Banyumas food such as mendoan, kripik ampas tahu, lemet, dage chips and utri was effectively improve the critical thinking ability of the elementary school students. Local food can be used by teachers and students as the learning media on a wide variety of material.

REFERENCES

- [1] Rasiman.: Leveling of Student's Critical Ability in Solving Mathematics Problem Based on Gender Differences. *International Journal of Education and Research*, 3 (4): 307-318 (2015)
- [2] Huang, Hi Fang. Ricci, F.A., & Mnatsakanian, M.: Mathematics Teaching Strategies: Pathways of Critical Thinking and Metacognition. *International Journal of Research in Education and Science (IJRES)*, 2 (1): 190-200 (2016)
- [3] Santoso, Budi Eko.: Mathematics Classroom Activities Based on Some Topics in Graph Theory to Develop Critical Thinking of Primary And Secondary School. *Ijiet*, 2(2): 154-160 (2018)
- [4] Nafiah, Y.N., & Suyanto, W.: Penerapan Model Problem Based Learning untuk Meningkatkan Kemampuan Berpikir Kritis dan Hasil belajar Siswa. *Jurnal Pendidikan Vokasi*, 4 (1): 125-143 (2014)
- [5] Saleh, M.: Strategi Pembelajaran Fiqh dengan Problem Based Larning. *Jurnal Ilmiah Didaktika*, 14 (1):190-220 (2013)
- [6] Rosa, M. & Orey, D.C.: Ethnomathematics: The Cultural Aspect of Mathematics. *Revista Latinoamericana de Enomatemática*, 4 (2): 32-54 (2011)
- [7] Albayrak, Mevhibe. & Gunes Erdogan.: Traditional Food: Interaction Between Local and Global Foods in Turkey. *African Journal and Business Management*, 4 (4): 555-561 (2010)
- [8] Abdullah, D.I., Zaenuri, & Sutarto, H.: Keefektifan Model Problem Based Learning Bernuansa Enomatematika terhadap Kemampuan Pemecahan Masalah Siswa Kelas VIII. *Unnes Journal of Mathematics Education*, 4 (3): 285-291 (2015)
- [9] Chahine, I. & Kinuthia, W.: Juxtaposing Form, Functin and Social Symbolism: An Ethnomathematical Analyze of Indigenous Technologies in the Zulu Culture. *Journal of mathematics & Culture*, 7(1): 1-30 (2013)
- [10] Yosopranata, Desinta, Zaenuri & Mashuri.: Mathematical connection ability on creative problem solving with ethnomathematics nuance learning model. *UJME*, 8(2): 108-113 (2018)
- [11] Zaenuri & Dwidayati, N.K.: Exploring ethnomathematics in Central Java. *Journal of Physics*, doi :10.1088/1742-6596/983/1/012108 (2018).