Etnomathematics of batik motifs in problem based learning

Zaenuri\textsuperscript{1*}, D Purwanti\textsuperscript{1} and M Asikin\textsuperscript{1}

\textsuperscript{1}Mathematics Department FMIPA Universitas Negeri Semarang, Indonesia

\textsuperscript{*}Corresponding author: zaenuri.mipa@mail.unnes.ac.id

Abstract. This research aims to analyze effectiveness of ethnomathematics with Solotigo Batik Motifs in Problem Based Learning model. This true experimental research design used cluster random sampling to take the sample. The sample was taken from SD N Siderejo Lor 07, Salatiga, as experimental class and SD N Sidorejo Lor 03 Salatia as control group consisted of 74 students. The data collecting techniques were observation, documentation, and test. The data was analyzed by One Sample T – Test, proportion test, and Independent Sample t-test. The findings showed that ethnomatematics with Salatiga batik motifs in problem based learning model was effective. It was shown by (1) the average ethnomatematics with Salatiga batik motifs in PBL model was higher than 75.0. (2) the proportion of passing grade by using ethnomatematics with Salatiga batik motifs in PBL model could achieve classical passing grade, 75%. (3) The average of ethnomatematics with the batik motifs in PBL was higher than PBL model. (4) the average of variance by using ethnomatematics with Salatiga batik motifs in PBL was higher than PBL model. It could be concluded that ethnomatematics with Salatiga batik motifs in PBL model was effective.

1. Introduction
Mathematics problem given to students at school has purpose to train them mastering their intellectual capability to understand, plan, do, and find solution of each faced problem. Heretofore, students learn mathematics by using inappropriate problems in their life. It makes them having difficulties to solve mathematics problems. To make such learning easier to understand, and to make them interested in learning, there is a need of meaningful learning by using surrounding problems around the students, especially local cultures where they live. It will make them not feeling bored and saturated in following learning process.

After observing and interviewing the teacher directly about their learning mathematics at fourth grade of SD N Sidorejo Lor 02, SD N Sidorejo Lor 03, and SD N Sidorejo Lor 07 in Imam Bonjol cluster of Salatiga, Central Java, it was known that the teachers did not have certain learning correlating to local cultures, included in learning mathematics.

Ethnomathematics has a relationship with multicultural views, so students find it easier to learn mathematics\textsuperscript{[1]}. The implementation of ethnomathematics as motivating and stimulating means of the students has purpose to solve saturation and learning difficulties\textsuperscript{[2]}. Ethnomathematics implemented in learning mathematics can recognize and use inter mathematics idea connection in solving a problem\textsuperscript{[3]}. Ethnomathematics is a learning approach that links mathematical material taught with local culture\textsuperscript{[4-8]}.

Various cultural products have links with mathematical concepts; various traditional house buildings related to the concept of geometry\textsuperscript{[9]}. Through such implementation, it is intended to make
students more understand mathematics and their cultures. Later, it will make teachers easy in instilling cultural values into their life.

An effort to find solution can develop a learning model by using model, strategy, and method plus technique to improve mathematics skill of students. Problem Based Learning (PBL) is an approach to motivate learning from real word [10]. Challenging learning for students can be done in solving problem done within a group [11]. According to Michael [12], PBL introduces problems at the beginning of the cycle as a context so that students are more motivated to solve problems. PBL is expected to make students able in analyzing independently and criticizing a problem.

Based on the research background, the problem formulations were (1) how was the average of ethnomatematics with Salatiga batik motifs in PBL model higher than 75.0, (2) how could the proportion of the passing grade by using the ethnomathematics in PBL model achieve minimum passing grade, 75% classically, (3) how could the average score of the ethnomathematics model in PBL model higher than ordinary PBL, and (4) what differences between using the ethnomathematics model in PBL and ordinary PBL model.

2. Research Methods
This true experimental research used Posttest Only Control Design. It had two groups selected randomly (R) as presented on Table 1.

| Table 1. Research Design |
|--------------------------|
| Pre-test Data | Group | Treatment | Test |
| The first semester score | Experiment | PBL model using ethnomatemics with selotigo batik motifs | Test |
| The first semester score | Control | PBL model without ethnomatemics with selotigo batik motifs | Test |

The population consisted of fourth graders of Imam Bonjol cluster in Salatiga during even semester in academic year 2018/2019. The technique of sampling was cluster random sampling. The results were SD N Sidorejo Lor 07 as experimental group intervened by PBL plus ethnomatematics by using Selotigo batik motifs and SD N Sidorejo Lor 03 as control group intervened by PBL only. The methods of collecting data were documentation, observation, and test. The techniques of analyzing the data were normality test, homogeneity test, one sample t-test, one proportion test, and Independent sample t – test.

3. Result and Discussion
Based on the initial data analysis, it was obtained that the samples were normally distributed. The population had homogeneous variances and the initial data average of both groups were equal. It showed that the samples had equal conditions. After the experimental group intervened by using PBL plus ethnomatematics with Selotigo batik motifs and the control group intervened by only PBL, the results were found as stated below (Table 2).

| Table 2. Final Test of the Students |
|-------------------------------------|
| Groups | N | Mean | Maxs | Min | Complete | Incomplete | Proportion |
| Experiment | 37 | 86 | 100 | 71 | 35 | 2 | 94 % |
| Control | 37 | 80 | 100 | 66 | 26 | 11 | 70 % |

From the analysis, it was gained that the test result of the experimental group reached minimum passing grade. Descriptively, 35 out of 37 students had reached minimum passing grade, 75. It meant the percentage of experimental group students’ achievement descriptively was 94%. Statistically, the
average score of the experimental group’s test was 86. Statistically, the average score could be seen from right side party \( t \)-test. It was gained \( t_{\text{count}} = 9.849 \) with significant level 5%. It was obtained \( t_{\text{table}} = 1.68 \). It was seen that \( t_{\text{count}} > t_{\text{table}} \). Thus, it could be concluded that the average score of the experimental group’s test was higher than 75.

Descriptively, the minimum passing grade achievement of the experimental group could be seen from \( Z_{\text{count}} = 2.66 \) with significant level 5%. It was obtained that \( Z_{\text{table}} = 0.3264 \). It was seen \( Z_{\text{count}} > Z_{\text{table}} \). It could be concluded that the proportion of the experimental group reached more than 75%.

Descriptively, the average score of the experimental group’s test was 86 while the control group was 80. Statistically, the average of variance test of both groups could be seen from \( t \)-test. From the calculation, it was gained \( t_{\text{count}} = 3.309 \) with significant 5%. It was gained \( t_{\text{table}} = 1.67 \). It could be seen \( t_{\text{count}} > t_{\text{table}} \). It could be concluded that the average score of the experimental group’s test was better than the control group.

Based on statistics test, the improvement of both groups’ test scores could be seen on the \( t \)-test. From the calculation, \( t_{\text{count}} = 2.342 \) with significant level 5%. It was obtained \( t_{\text{table}} = 1.67 \). It can be seen \( t_{\text{count}} > t_{\text{table}} \). It could be concluded that the improvement of the experimental group was better than the control group.

The local cultures in Salatiga during learning process by using PBL and ethnomathematics with Selotigo batik motifs in Salatiga, Central Java can be seen on the figures below.

![Figure 1](image1.png) Figure 1. Plumpungan Batik Motif

![Figure 2](image2.png) Figure 2. Waturumpuk Batik Motif

![Figure 3](image3.png) Figure 3. Waturumpuk Batik Motif

Figure 1, Figure 2, and Figure 3 are plumpungan batik motif and waturumpuk batik motifs. The bold lines show the batik motif with square, rectangle, and triangle patterns. The results of the students’ test scores in experimental group, taught by PBL and the ethnomathematics model, was better than the control group taught by only PBL. It was due to the experimental group’s learning was more active to discuss in solving and explaining the discussion result in front of the class.

The analysis of final data of both groups showed that the experimental group test result taught by PBL and the ethnomathematics model was better than control group, taught without ethnomathematics. It was due to: students taught by PBL and ethnomathematics model with Selotigo batik motifs gained more question and LKPD questions of the materials were connected to Selotigo batik motifs. The students taught by PBL model and the ethnomathematics were active to ask and discuss about the materials which were not understood, presented in the form of Selotigo batik motifs. They asked their friends and the teacher.

The findings was in line with a study that told mathematics learning based ethnomathematics could make students active in mathematics learning process. [13] assert ethnomathematics is the application of ideas and procedures to members of certain cultural groups in a different and sustainable context until now. Learning with ethnomathematics nuances was better than common learning [14]. The average of mathematics skill of the class implemented ethnomathematics learning was better than conventional class learning [15].

4. Conclusion
Based on the findings about PBL by using ethnomathematics with Selotigo batik motifs on perimeter and area of two dimensional figure was effective because: the average score of ethnomathematics with
Selotigo batik motifs in PBL model was higher than 75.0, the proportion of minimum passing grade of the students taught by PBL and the ethnomatematics reached minimum passing grade 75% classically, the average of ethnomatematics with Selotigo batik motifs in PBL was higher than PBL only group, and the average of variance of the group taught by PBL and ethnomatematics was higher than PBL only group.

References
[1] Brandt A and Chernoff EJ 2014 Ohio J. Sch. Math. 71 31
[2] Abdullah D I, Mastur Z and Sutarto H 2015 Unnes J. Math. Educ. Res. 4 285
[3] Rizka, Mastur Z and Rochmad 2014 Unnes J. Math. Educ. Res. 3 72
[4] Furuto L H L 2014 Teach. Math. Its Appl. 4 1
[5] Vasquez E L 2017 J. Educ. Hum. Dev. 6 117
[6] Maure L M et al 2018 Acad. - Educ. Res. Rev. 13 307
[7] Dwidayati N and Zaenuri 2019. J. Phys.: Conf. Ser. 1321 032010
[8] Zaenuri, Kurnia B, Dewi NR and Dwidayati N 2019. J. Phys.: Conf. Ser. 1321 032009
[9] Kucuk A 2013 Rev. Lat. Am. Etnomatematica 7(1) 171
[10] Siriwat R and Katwibun D 2017 Proceedings Of The 40th Annual Conference Of The Mathematics Education Research Group Of Australasia 474
[11] Widyatiningtyas R, Kusumah Y S, Sumarno U and Sabandar J 2015 J. Math. Educ. 6 30
[12] Argaw A S, Haile B B, Wollega B T A and Kuma S G 2017 EURASIA J Math Sci and Tech Ed 13(3) 857
[13] Rosa M and Orej DC 2016 Journal of Humanistic Mathematics 6(2) 1
[14] Barata A, Zaenuri and Sukestiyarno 2019 Unnes J. Math. Educ. Res. 8 1
[15] Kaselin, Sukestiyarno and Waluyo B 2013 Unnes J. Math. Educ. Res. 2 122