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# Ethnomathematics and Outdoor Learning to Improve Problem Solving Ability

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***Abstract*—Students often have difficulty doing mathematical problems. The outdoor learning with ethnomathematics approach is one solution. The purpose of this study was to determine the increase of the problem solving ability of senior high school students through the application of outdoor learning model based on Bengkulu ethnomathematics. This study was a pre-experimental. It was uses the pretest-posttest group design. The sample is 40 students that selected of whole student at the senior high school Bengkulu. The research instrument used was the test of mathematical problem solving. Data were analyzed by using statistical analysis. The results showed that mathematical problem solving abilities of students after being given ethnomathematics with outdoor learning models were higher than before being given the learning models.**

***Keywords—mathematics problem solving; ethnomathematics; outdoor learning***

## I. INTRODUCTION

Problem solving ability is one of the competencies students must have in learning mathematics. But students feel that mathematics is something scary, especially problem solving. In fact, solving mathematical problems has become an important aspect of new mathematics [1], problem solving and study skills are potential areas for further improvement in learning [2]. Therefore, problem solving skills should be owned by students early on.

In solving problems students need metacognition [3]. Because, metacognition in problem solving helps problem solvers to recognize the existence of problems that need to be solved, to understand what the problem really is, and to understand how to achieve the goal (solution) [4]. The results Dewi et al. showed that subjects with high cognitive level were able to think metacognitively with the mathematical communication process through planning, monitoring and evaluating the thinking process in the mathematical communication process [5]. The subjects with low cognitive level are doing mathematical communication in the form of planning, and monitoring but not exactly in evaluating the thinking process. While subjects with low cognitive level can make planning but can not monitor and can not evaluate the thinking process. Problem solving is a skill in which students could formulate a variety of unique ways to solve a problem. This means that a student might not always end at the correct answer or the person sat next to his may have a completely different method of arriving at an answer [1].

Therefore the teacher must be able to manage mathematics learning appropriately. It was needed a learning model that was in accordance with students' initial abilities and available teaching materials [6]. In such a situation, learning begins with contextual problems [3] and ethnomatematics [7-9]. This makes it easier for students to do the mathematics learning process. The process of horizontal towards vertical so that the mathematical concepts and principles are produced [10]. Students do invention or reinvention [11,12]. Learning models that meet these criteria are ethnomatematics learning approaches that are taught through outdoor learning [12].

Ethnomathematics makes local culture a starting point for learning mathematics [6]. With such an approach, the teacher is easier to manage learning when students learn directly at sites or places where the culture grows and develops [3]. This is outdoor learning [13]. Hagen's research results, that the students seem to enjoy the outdoor activities [14]. They were enjoy mathematical assignments that the students experience as difficult. In all students a turning point was observed in students attitude towards nature. Students became more used to, less scared of or highly enthusiastic about nature. This change in attitude could possible influence students' enjoyment.

Students are guided to achieve mathematical concepts/principles through discovery [15]. The problem solving ability of students who are taught with guided discovery models is higher than students taught with traditional learning [16]. The mathematical understanding of students learned the ethnomathematics oriented materials was higher than those learned non-ethnomathematics oriented materials (realistic mathematics learning applied in both groups). On the contrary, mathematical understanding of students who learned the ethnomathematics oriented materials was lower compared to the students learned the non-ethnomathematics materials (the conventional learning method applied in both groups) [6].

The results of the study show that the ability of mathematical understanding of students who are learning oriented ethnomathematics higher than students who learn is not ethnomathematical oriented after controlling the cognitive style of students [17]. Other thing that the subjects with high

cognitive level were able to think metacognitively with the mathematical communication process through planning, monitoring and evaluating the thinking process in the mathematical communication process. Subjects with cognitive level are doing mathematical communication in the form of planning, and monitoring but not exactly in evaluating the thinking process. While subjects with low cognitive level can make planning but can not monitor and can not evaluate the thinking process [5]. This study demonstrates a significantly higher level of physical activity when indoor and outdoor learning contexts are combined [18].

In recent years, teaching mathematics in an outdoor setting has become popular among teachers, as it seems to offer alternative ways to motivate children's learning [13]. Outdoor learning with the ethnomathematics approach has a positive impact on mathematical abilities. Because, the mathematical understanding of students learned the ethnomathematics oriented materials was higher than those non-ethnomathematics (the realistic mathematics learning applied in both groups) [6]. Also, the outdoor learning method affects students' mathematical critical thinking skills [19].

The outdoor learning method uses outdoor settings [19], contextual media as a means [20], more ethnomathematics in the open [5]. Therefore, through outdoor learning, students can interact with real learning media [19], students move physically and mentally well. The increased physical activity level found during outdoor learning is comparable to the total activity level of a normal school day, and is of great importance if linked to physical health and cognitive benefits [18].

In outdoor learning activities and ethnomathematics oriented, students take advantage of more realistic learning media. According to Widada contextual learning media can effectively produce patterns that students can easily construct conjectures and with vertical mathematical activity, students with the help of more capable friends or teachers can achieve the concepts and principles they are learning [20]. The results of the implementation of contextual learning media (environment based and ethnomathematics), there are more than 82% of students in Bengkulu able to reach the concepts and principles correctly.

Students solved mathematical problems through mathematization process based on ethnomathematics, students were aware that ethnomathematics was the starting point of horizontal mathematical activity [3]. The students who were given ethnomathematics-oriented materials, mathematics understanding ability of those learned by implementing the realistic mathematics learning approach was higher than students those used the conventional learning approach after controlling the students' initial ability [6]. The mathematical communication skills of students who learning by using ethnomathematics-oriented material are higher than those given non-ethnomathematics [21]. On the contrary, if students who are given mathematics material are not ethnomathematics-based, then the mathematical representation ability of students to be taught with inquiry learning models is lower than students taught with conventional learning models [22]. Because, the ethnomathematics was stresses student's competence developed in different cultural groups in their everyday life, the idea of mathematical literacy mainly focuses on the mathematical and societal requirements to student's competencies [23].

The results of study from Herawaty & Widada, shows that influence of contextual learning model (as the outdoor learning) based on the cognitive conflict on mathematical problem-solving ability was better than conventional learning model when controlled by cognitive style covariate [24]. Also, the influence of contextual learning model based on the cognitive conflict on the ability of students to understand the concept of mathematics better than conventional learning model when controlled by cognitive conflict covariate. These two conclusions mean that the ability to comprehend the concept and problem solving of math students of Bengkulu which through contextual learning model of mathematics based on cognitive conflict of students experience a very high increase.

The ability to understand the concept of trigonometry of students taught by the learning model of connected mathematics (with outdoor) is higher than students who are taught conventionally for students who learn through the scientific approach [25]. The problem solving ability of taught students with the Relating, Experiencing, Applying, Cooperating, and Transferring learning strategies (in the outdoor) is higher than students taught with traditional learning. The problem solving abilities of students who are taught with guided discovery models is higher than students taught with traditional learning [16]. The students exposed to ethnomathematics teaching approach were superior in achievement and retention than those exposed to conventional teaching method. In general, ethnomathematics teaching approach has proved to be a viable option in promoting meaningful learning [26]. Thus, we hypothesize that ethnomathematics-oriented learning with outdoor learning settings can improve mathematical problem-solving abilities.

## II. METHOD

The research was experimental with pre-experiment method. We was implementing ethnomathematics with outdoor learning models. The design was a pretest-posttest group design. The population was all students of senior high school in the Kota Bengkulu. Samples were randomly selected as many as 40 students. The research instrument was a test of the problem solving abilities of mathematics. Before the learning, students were tested for their abilities. During the learning an ethnomathematics with outdoor was implemented. After the treatment was applied to the experimental class, students were tested for problem solving abilities. The results of the pretest and posttest data were analyzed by using the correlated t-test data.

## III. RESULTS AND DISCUSSIONS

Based on the score of problem solving ability of the experimental class students through ethnomatematics learning with outdoor math in high school, analyzed by using statistical tests, the results are presented in Figure 1.

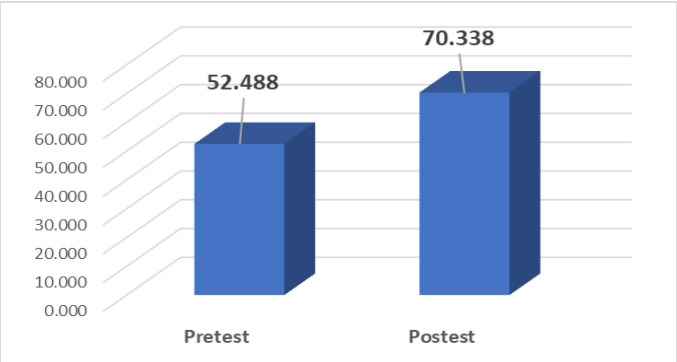


Fig. 1. Score of pretest-posttest of the problem solving ability.

Based on Figure 1, the average of posttest scores is 70.338 and for pretest only 52.488. The data shows that there were 17.85 as an increase in problem solving abilities. This difference in scores is quite high. See Table 1, this was proven by N-gain (=g) = 0.376. This shows that 0.7> g ≥ 0.3, the N-gain generated is in the medium category.

TABLE I. PAIRED SAMPLES STATISTICS

| | | Mean | N | Std. Deviation | Std. Error Mean |
|---|---|---|---|---|---|
| Pair 1 | X2 | 70.338 | 40 | 6.380 | 1.00884 |
| | X1 | 52.438 | 40 | 6.497 | 1.02722 |

The data was correlated data. To determine the level of correlation between pretest and posttest was tested through the correlation coefficient as shown in Table 2.

TABLE II. PAIRED SAMPLES CORRELATIONS

| | X1 | X2 |
|---|---|---|
| Pearson Correlation | 1 | 0.624** |
| Sig. (2-tailed) | | 0.000 |
| N | 40 | 40 |
| Pearson Correlation | 0.624** | 1 |
| Sig. (2-tailed) | 0.000 | |
| N | 40 | 40 |

**. Correlation is significant at the 0.01 level (2-tailed).

Based on Table 2, the paired samples correlations was r = 0.624. The correlation is significant at the 1%. Thus, the relationship between pretest and posttest scores was positive and significant. Therefore, we continue with the t-test of paired differences, note Table 3.

TABLE III. THE T-TEST PAIRED DIFFERENCES

| | Paired Differences | | | t | df | Sig. (2-tailed) |
|---|---|---|---|---|---|---|
| | *Mean* | *Std. Dev.* | *Std. Error Mean* | | | |
| X2 - X1 | 17.9 | 5.584 | 0.883 | 20.274 | 39 | 0.000 |

Based on Table 3, the standard deviation is 5.584 and t count is 20.274 with the degree of freedom 39, then p-value = 0.00 <0.05. This states that Ho is rejected. This means that there are significant differences in students' mathematical problem solving abilities between before and after being given ethnomathematics learning with outdoor learning models. Because the improvement of problem solving ability was 17.85, and N-gain = 0.376 (see the description of Figure 1), the conclusion was that mathematical problem solving abilities of students after being given ethnomathematics with outdoor learning models were higher than before being given the learning models.

The results of this study support previous studies. The ability of students to understand mathematics given material oriented ethnomathematics was higher than students who studied non-ethnomathematics material after controlling students' initial abilities. This is for students to learn through realistic mathematical learning approaches [6,22,27]. Therefore, it is appropriate that learning mathematics through ethnomathematics be implemented in schools, and integrated with the curriculum.

The new high school mathematics program in China, integrates ethnomathematics into the mathematics curriculum, such as curriculum with vector teaching examples [28]. Mathematics teachers are challenged to deal with the cultural diversity of people that occur in each classroom setting. Ethnomathematics has clearly gained an important role, in the Western curriculum, being meaningful in exploring various aspects of mathematical literacy. The ethnomathematics are enriched as an alternative, the implicit philosophy of school mathematics practice [29]. We were to integrate ethnomathematics and mathematics curriculum, and with the integration, the inherent mathematical value in special cultures and societies will be understood and respected [28].

Most mathematics teachers use the ethnomathematics approach to teaching. The results also show that there is no significant difference between male and female math teachers in the use of the ethnomathematics approach to teaching and there is no significant difference between rural mathematics teachers and their urban counterparts in the use of the ethnomathematics approach to teaching [30]. Thus ethnomathematics learning can be applied by anyone and anywhere.

## IV. CONCLUSION

Based on the results of statistical analysis, it can be concluded that: the increase in problem solving abilities was 17.85, with the N-gain = 0.376. The gain of scores was medium category. There are significant differences in students' mathematical problem solving abilities between before and after being given ethnomathematics learning with outdoor learning models. Finally, the mathematical problem solving abilities of students after being given ethnomathematics with outdoor learning models were higher than before being given the learning models.

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