Problem-based learning and ethnomathematics on mathematical understanding

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Abstract. Mathematical understanding is very important aspect for students in elementary school. However, the mathematical understanding is still low. Innovative learning mathematics is chosen as a solution to improve mathematical understanding by using problem-based learning and ethnomathematics. The purpose of this research is to know how the effect of problem-based learning approach with ethnomathematics on mathematical understanding. The method used in this research was Four-D models which consists of: Defining, Designing, Developing, and Disseminating. The subjects of this research consisted of 83 students from fourth grade elementary school. The selected samples of research will be divided into experimental class and control class. The instruments used were the mathematical understanding test, and student response questionnaire. The result of the research showed problem-based learning and ethnomathematics have a positive effect on mathematical understanding. Problem-based learning and ethnomathematics is better than conventional learning to improve mathematical understanding. The new finding in this research from the questionnaire result was students prefer modern culture rather than local culture.

1. Introduction
Mathematics is one of the subjects that is taught to students in elementary school. Mathematics can be found in various forms of daily life activity such as trading and measurement of distance that can be solved by mathematics [1]. Mathematics is used to help students in understanding and solving the mathematical problems in everyday life. There are some standards process ability in mathematics, one of them is mathematical understanding [2]. Mathematical understanding will lead students to be creative in finding the new knowledge as a solution to solve the real life problems [3,4]. Perceptions, ideas, thoughts, creativity, and higher-order thinking are needed in mathematical understanding [5]. mathematical understanding in developed countries is at a good level, but some developing countries mostly mathematical understanding at a low level [6,7]. The wrong mathematical theory, and learning activities will lead to misconception that makes students have a wrong understanding about the knowledge [8]. The low ability of mathematical understanding needs to be completed that students do not misconception on applying mathematics in other fields of knowledge, and everyday life.

Mathematical understanding is still low because understanding mathematical theories is wrong, and learning process is too long. Learning activities that solve problems, and student-centered will motivate students to be active in the learning process [9]. The problem solving process are involved students thinking, being creative and finding mathematical understanding. However, students experience difficulties in solving problems, cultural-based problems will help students because related to students' knowledge. The problem that often occurs on some developing countries are the lack of learning
facilities, but they have abundant natural and cultural resource she learning process will not great because the facilities for learning are not standard.

To solve the problem, several researchers have suggested the following strategies: problem-based learning—an efficient learning strategy [10], problem-based learning model via virtual learning [11], web-based problem-based learning approach [12], and problem-based learning using systems approach [13]. However, there has never been a research of problem-based learning and ethnomathematics on the learning process to improve mathematical understanding. Mathematics and culture will help students to solve the problems using culture. The purpose of the research is to apply problem-based learning, cultural, and mathematics. The research was applied to integers in elementary school. Computational understanding, and rational understanding are the focus of research. The culture used are Indonesian cultures. The learning process are a student-centered, a cultural-based problem, and cultural that used such as games, language, and local culture to solve the problem. Problem-based learning and ethnomathematics used to construct the ability of mathematical understanding.

2. Method
This research used Four-D models (research design) which consists of: Defining, Designing, Developing, and Disseminating [14]. The subjects of this research consisted of 83 students from fourth grade elementary school. The subjects are divided into two groups, problem-based learning and ethnomathematics is experimental group, and conventional approach is control group. The instruments used were the mathematical understanding test, and student response questionnaire. Research design is shown in Figure 1.

3. Results and discussion
3.1. Defining
Problem-based learning is student-centered learning, real problems, applying small or large groups to discussion, and students concluding the right solution [15-17]. Mathematical understanding is the ability of students to understand mathematical ideas with thought processes to gain new knowledge, when students have the ability to understand mathematics can adjust to new tasks and solve problems [18, 19]. Ethnomathematics are a blended of cultural and mathematics, cultural used for concrete problems, and solve the problems [20]. Problem-based learning, ethnomathematics, and mathematical understanding are studied to learning design.

3.2. Designing
In designing stage, researcher constructed the learning steps, lesson assignment format, and evaluation format. Learning activity was divided into cultural-based problem orientation, group investigation using ethnomathematics, presentation of solution result based on ethnomathematics, analysis and evaluation. Each steps of learning process have their own purposes, as can be seen in Figure 2.
3.3. Developing

3.3.1. Cultural-based problem orientation. Students were given the problem that started from culture, then refer to the mathematical problem. Cultural-based problem will direct students to find the local wisdom. Students used the culture to build their initial concept in solving the problem with ethnomathematics. Cultural-based problem is shown in Figure 3.

3.3.2. Group investigation based on ethnomathematics. The problems should be finished in groups. The problem solution that was done by students will utilize the culture, such as traditional games, language, and traditional food. Group investigation using ethnomathematics can be seen in Figure 4.

3.3.3. Presentation of solution result based on ethnomathematics. The problem solution is delivered in the form of written report. The problem solution result will be presented to the other group. This activity will trigger students to discuss about the answer of the other groups. The presentation of solution result based on ethnomathematics is shown in Figure 5.
3.3.4. Analysis and evaluation. Teacher guided students to analyse the improper understanding. Analysis was done by reflecting of problem solution result. Then, students distinguished between the correct answer with the incorrect ones, and constructed a conclusion based on the learning activities.

3.4. Disseminating

Problem-based learning and ethnomathematics strategies was implemented in the concept of integer. The improvement of students’ mathematical understanding was measured by three kind of step, which are pre-test, treatment, and post-test. Pre-test and post-test that given to students are mathematical understanding test, and students’ response questionnaire. Figure 6 the average score of mathematical understanding and students’ response questionnaire.

![Figure 6](image)

**Figure 6.** The average score of mathematical understanding and students’ response questionnaire.

Based on Figure 6, the improvement of mathematical understanding by using problem-based learning approach with ethnomathematics strategy is significantly improved as much as 40.75 point. This result showed that the use of problem-based learning and cultural approaches in mathematics can improve students' mathematical understanding.

The new finding is found in this research; students’ response towards problem-based learning with ethnomathematics strategy is not significance. In summary, students prefer modern culture rather that local culture. The facts have been proved that the development of technology and information make students familiar with the modern culture, such as television shows, internet, and online games. The other cause showed that the elementary books based on discover the meaning from local culture is rarely found.

The role of parents and teacher in directing students to recognize the local culture, and utilize technology in everyday life will affect students’ attitude at home. Students should be directed to recognize the benefit of technology and local culture it-self, so in order students will be able to select the benefit among technology and local culture. Integration between the role of teacher, parents, students, technology utilization, and local culture will make students have the characters that are in line with the local wisdom without leaving the advanced of globalization. The new finding about students prefer the modern culture rather than the local culture are expected to be concern by educators, so they should think creatively in planning, implementing, and evaluating the learning activities especially in elementary school. The learning process that engaged students to discover something will be more meaningful in the cognitive aspect and affective aspect, it will become the important thing in the learning process without put aside the local culture which is full of character value.

4. Conclusion

Problem-based learning approach with ethnomathematics strategies can improves students’ mathematical understanding. The integration between teacher performance, student activities, and the use of infrastructure can improve mathematical understanding. On the whole, learning process that
emphasizes students to be actively engaged in building the understanding will be better than learning process that prioritizes students as recipient of information in improving mathematical understanding.

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