The ability to solve mathematical problems through realistic mathematics learning based on ethnomathematics

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Abstract. Problem-solving is one of the goals of mathematics learning. Ethnomimetic-based realistic mathematics learning is learning with starting-point contextual problems that are close to students' minds. This study aims to determine the effect of ethnomathematics-oriented realistic mathematics learning on problem-solving abilities. That is a type of quasi-experimental research. The study design was a non-equivalent control group. The population is SMA N 2 Kota Bengkulu in 2019. The sample of this study was 68 students from Class X MIPA A and X MIPA D. The research instrument was a test of problem-solving skills. Data were collected through tests and analysed by covariate analysis. The results of this study are that realistic mathematics learning oriented to ethnomathematics has a positive effect on the ability to solve. The conclusion is that realistic mathematics learning with ethnomathematics orientation can improve mathematical problem-solving skills for secondary school students. We suggest that mathematics teachers can develop realistic mathematics learning tools with ethnomathematics as a starting point for learning.

1. Introduction

Mathematics is an excellent subject for the development of students' intellectual competencies. They are able to reason logically, spatial visualization, analysis, and abstract thinking. Through learning mathematics, students develop the ability to count, reason and solve problems [1]. Students are trained to solve mathematical problems. Therefore, he must be able to understand the problem. It is determined by the ability to read the given problem. The results of the study show that students' problem-solving skills vary. That is dependent on their reading level. Students often have difficulty reading the statement of the problem [2].

There are at least two types of problem-solving, namely non-routine and routine problems. Non-routine problem solving is an important skill. Routine problem solving is also a necessary skill. Problem-solving from routine problems does not only apply procedural skills because once again there is a step where students must decide which procedures to apply [3]. In order for students to have problem solving abilities, effective learning approaches are needed for these skills. It is important to develop problem-solving abilities in students which are prerequisites needed for solving complex problems in the future [4]. The approach that fulfils it is realistic mathematics learning with starting-
point ethnomathematics problems [5]. Their results show that students who are given material oriented to ethnomathematics, the ability of understanding mathematics from those who learn by applying realistic mathematics learning approaches is higher than students who use conventional learning approaches after controlling students' initial abilities. It is a learning approach that can improve students' metacognitive abilities in solving mathematical problems [6]. Realistic mathematics learning has a positive impact on mathematical abilities. The results showed that there was an effect of covariate cognitive conflict on the average ability of concept understanding for students taught by contextual learning models better than conventional learning models. Also, there is an influence of covariate cognitive conflict on the average problem-solving ability for students taught by contextual learning models better than conventional learning models [7]. Therefore, realistic mathematics learning based on ethnomathematics can replace conventional approaches. Students who follow these lessons can re-inventions the concepts and principles of mathematics [8]. It is learning with contextual problems as a starting point [9,10]. The learning approach with the right syntax [11].

Learning mathematics through a realistic mathematical approach means doing mathematics, which solves the problems of everyday life. That is an important part. Students must be given the opportunity to rediscover mathematical concepts and that the teaching-learning process becomes very interactive [12]. In learning mathematics with a starting point is a contextual problem, the ability of students to solve various types of problems is an important necessary condition. The contextual problem given must contain the achievement of concepts and critical thinking skills. That is something that potentially involves students in making mathematical understanding. Students must build understanding by reflecting and communicating. Therefore we need a problem that can encourage students to use their cognitive abilities well during the learning process and the internalization process. To be able to carry out the problem-based learning process, it is necessary for educator's knowledge about good problems [11,13].

The realistic mathematics learning approach based on ethnomathematics is the right choice to improve problem-solving skills. Ethnomathematics means mathematics in culture [14,15]. It becomes important for students in starting mathematics learning, thereby reducing the impression that mathematics is very structuralist and mechanistic [10,16]. The learning becomes more empiricist [9]. The ethnomathematics is a learning paradigm that can raise awareness about how students can learn most effectively [17]. Ethnomathematics and mathematical literacy are the two main ideas about knowing mathematics in the world. The ethnomathematics emphasizes the competence of people developed in different cultural groups in their daily lives. Whereas, mathematics literacy mainly focuses on mathematical and social requirements for people's competencies [18]. Learning mathematics through an ethnomathematics approach and good mathematical literacy increases meaningfulness in learning.

Mathematics learning with an ethnomathematics approach needs to be emphasized. It is making learning meaningful, relevant and interesting [19]. The ethnomathematics studies aspects of mathematical culture. It presents mathematical concepts related to students' cultural and daily experiences. Students experience an increased ability to decipher meaningful connections and deepen their understanding of mathematics. The ethnomathematics approach helps develop students' intellectual, social, emotional, and political learning by using their own unique cultural references. That is to instil their knowledge, skills, and attitudes [20-22]. Thus, we are interested in examining the effect of ethnomathematics oriented mathematics learning on problem solving abilities.

2. Methods
This research is applying a quasi-experimental approach, with a non-equivalent control group design. The population in this study were all students of SMA N 2 Bengkulu City. The sample in this study was 68 students from class X MIPA A and X MIPA D. The instrument of this study was the test data for problem-solving abilities. Tests given in the experimental class of high school mathematics learning models are ethnomathematics-oriented realistic mathematics learning and control classes of conventional learning models in the form of descriptions with the same problem with a total of 5
questions. The problem-solving ability test was validated beforehand and tested until it reached a standard instrument. That is achieving a high level of validity and reliability. The test aims to determine the score of students’ problem-solving abilities before and after learning mathematics that is ethnomathematics oriented. Also, for conventional learning model classes. Data were analysed by analysis of covariates (ANCOVA).

3. Results and discussion

This study applies a realistic mathematics learning approach based on ethnomathematics. To find out the positive effect, we compare it with the traditional approach to other groups of students. The results show a quantitative descriptive comparison of the ability to solve mathematical problems, see Figure 1 for the experimental class, and Figure 2 for the control class.

![Figure 1. Percentage of problem solving abilities of experimental class students](image.png)

Students are given mathematical problems in the experimental class. Figure 1 shows that there are 82% of students able to understand the problem of learning through a realistic approach to mathematics based on ethnomathematics. There are 78% of students in the group are able to make mathematical models to solve the given problem. 75% of the students are able to solve problems based on the model they are compiling. Finally, there are 67% of students who can solve original problems based on the completion of the model. That is a better level of understanding compared to students in the conventional group (see Figure 2).
Based on Figure 2, given 67% of students from the control group were able to answer the given problem. 56% of students in this group can make mathematical models. There are 52% who can solve problems based on the mathematical model they have prepared. From the traditional student group, there are 47% who can solve the problem completely. This shows something that is less encouraging when compared to other group students.

Based on the data, the score of students' problem solving abilities after applying ethnomathematics-oriented realistic mathematics learning in the experimental class obtained an average of 80.24. The minimum score is 68, and the maximum score is 92, with a standard deviation of 6.72.

Next, in order to issue a statistical hypothesis, a prerequisite test consists of the normality test, homogeneity test, and linearity test on the pre-test and post-test data. Statistical test results show the data of the two classes are normally distributed. The data of both classes also have the same variant, which means homogeneous. The data also shows a linear regression equation. Therefore, we can continue testing the hypothesis through Ancova, delivered as listed in Table 1.

### Table 1. ANACOVA test results of research data.

| Source          | Type III Sum of Squares | df | Mean Square | F      | Sig.  | Partial Eta Squared |
|-----------------|-------------------------|----|-------------|--------|-------|---------------------|
| Corrected Model | 2388.897a               | 2  | 1194.449    | 20.770 | .000  | .390                |
| Intercept       | 20879.989               | 1  | 20879.989   | 363.083| .000  | .848                |
| Pretest1        | 287.662                 | 1  | 287.662     | 5.002  | .029  | .071                |
| Class A         | 2257.785                | 1  | 2257.785    | 39.261 | .000  | .377                |
| Error           | 3737.985                | 65 | 57.507      |        |       |                     |
| Total           | 385334.000              | 68 |             |        |       |                     |
| Corrected Total | 6126.882                | 67 |             |        |       |                     |

Table 1 shows the testing of hypotheses about the effect of ethnomathematics oriented mathematics learning approaches on problem-solving abilities. The Class A row in the table shows that the F count is 39,261. That is at a significance of 0.000 <0.05, which means Ho is rejected. Thus, there is the influence of ethnomathematics-oriented realistic mathematics learning approaches to problem-solving abilities. Figure 3 is an example of students' resolution in solving Bengkulu-Indonesia "Dam Taksudah" Lake Width problem. It is one of the favourite recreation areas in the area.
Examples of student completion in Figure 3 are the problem-solving groups of students applying a realistic mathematical approach to recreation. The influence of realistic mathematics learning approach oriented ethnomathematics on the ability of problem solving is seen when the learning process that occurs in and outside the classroom. Ethnomathematics is mathematics in student culture. It is an orientation that is close to students' minds. Another finding is that students are more motivated to learn mathematics, because the material taught is very close to daily life [23]. Ethnomathematics is expressing the relationship between culture and mathematics [24]. The results, show that the ability of students during ethnomathematics learning has improved. In understanding the derivative problem, students can apply derived properties, it coordinates at least two adjacent and overlapping intervals, but not for all intervals in the domain. They can coordinate so as to form objects about intervals. Students can process the properties of functions at an interval in the h domain so that an object is formed about a graph sketch of the function [25]. The results other, there is a significant difference in students' mathematical problem-solving abilities between before and after being given ethnomathematics learning with outdoor learning models. The students' mathematical problem-solving ability after being given ethnomathematics with an external learning model is higher than before being given a learning model [26]. Thus, we believe that realistic mathematics learning approaches oriented towards ethnomathematics can replace traditional learning.

4. Conclusions
The conclusion of this research is that there is an influence of ethnomathematics oriented mathematics learning approach to students' mathematical problem-solving abilities by controlling the initial ability of mathematical problem solving. We suggest that mathematics teachers can develop realistic mathematics learning tools with ethnomathematics as a starting point for learning.

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