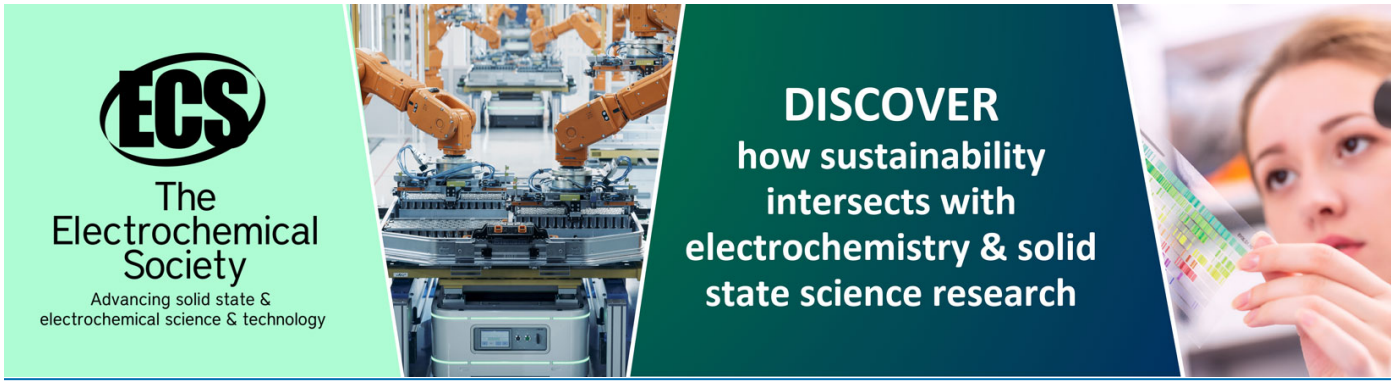
Ethnomathematics-based learning using oil palm cultivation context



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Ethnomathematics-based learning using oil palm cultivation context

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Abstract. Agriculture is a culture that has been embedded in Indonesian society. Along with the changing times, then this culture began to be abandoned and tend not to be known by the current generation. Ethnomathematics exists to bridge the gap between culture and education. The purpose of this study was to find out the mathematical ideas on oil palm cultivation and determine students' responses in Ethnomathematics-based learning. This research uses descriptive qualitative. In this study, an assessment of the knowledge, ideas, or findings contained in the literature was carried out to provide theoretical information and interviews to oil palm companies and smallholders related to oil palm cultivation and implemented in mathematics learning. The application of agricultural activities in mathematics learning is expected to introduce and preserve agricultural culture to students and learning becomes more fun and meaningful.

1. Introduction

One of the things that influences the achievement of the goals of mathematics learning by students is if mathematics ability can be mastered by students well [1]. Based on NCTM some abilities that students must achieve in learning mathematics one of which is problem solving [2]. Learning to solve problems is the main reason in learning mathematics and the ability to solve problems is the main capital for learning mathematical skills and concepts [3]. Problem solving is the essence, cannot be separated from mathematics and has a role as the core of the domain of competence in the implementation of the mathematics learning process [4, 5]. Interesting learning needs to be given early so that mathematics is liked so that students do not experience difficulties in solving problems [6].

On the results of the PISA (Program for International Students Assessment studies) conducted in 2015, Indonesia was ranked 69th out of 76 countries [7]. There are still many students who experience difficulties in learning geometry [8]. According to the results of the 2015 National Examination, the subject of geometry is at a low presentation [9]. The analysis of National Examination Preparation also showed that only 44.75% of students were able to solve geometry problems. In Indonesia a number of facts show that the geometry achievement of junior high school students still needs to be improved. In the 2011 Trends in International Mathematics and Science Study (TIMSS) Report, it was stated that from 43 geometry questions, the average correct answers of Indonesian students only reached 39% while Indonesian students only reached 24%. It was further explained that in general the potential of junior high school students in Indonesia was at a low level, namely at the level of knowing, not yet reaching the level of applying, understanding, let alone reasoning [10].

On a national scale, based on the junior high school national examination report for three years in a row it is known that the mastery of Indonesian students' geometry is at a low percentage, namely in 2013/2014 reaching 62.4, in 2014/2015 it reached 52.44 and in 2015/2016 it decreased to 47.19. Based on the results of daily tests for geometry material class VII the results are still a lot under the minimal completeness criteria. Based on the percentage of the absorption of the national examination shows the percentage of mastery of material related to geometry at Muara Enim Regency has decreased in 2013/2014 by 80.17; in 2014/2015 it decreased to 63.77 and in 2015/2016 it decreased again to 59.75.

Meaningful learning is learning that places more emphasis on daily life (realistic). Ethnomathematics is a term that arises based on the similarity between culture and mathematics which is a study to find specific or unique features on mathematics that arise and develop in certain groups of society. Ethnomathematics learning is more suitable to use because it is a realistic mathematics learning [11]. [12] Ethnomathematics grows and develops from culture, so that it makes the existence of Ethnomathematics often unnoticed by the user community. Ethnomathematics itself uses mathematical concepts broadly related to mathematical activities. That is, Ethnomathematics are not fixated on one theoretical study but many theoretical studies such as agriculture, architecture, clothing motifs, weaving, ornaments, kinship, and spiritual relations.

The term of ethnomathematics was first introduced by D'Ambrosio in 1978 at the annual meeting of the American Association for the Advancement of Science (AAAS) [13]. Subsequently in 1985, D'Ambrosio, Gloria Gilmer and Rick Scott formed a group known as The International Study Group on Ethnomathematics (ISGEm), whose aim was to increase the understanding of mathematical practices on cultural diversity and apply the knowledge for the purpose of education and development. Ethnomathematics is the mathematics which is practiced among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on [14]. Furthermore, it defines ethnomathematics as the intersection of mathematics with the historical, cultural, and social roots of mathematic, and also that the ethnomathematics comes from the combination of two words - ethno and mathematics, where ethno denotes the socio-cultural context, and mathematics talks about mathematical knowledge such as counting, weighing, measuring, comparing, sorting, classifying, designing, and playing [15]. Ethnomathematics includes ideas, procedures, processes, methods, and practices that are rooted in different cultural environments. Therefore, etnomathematics is so related to mathematics and culture in the nation [16].

With Ethnomathematics, mathematics which has been considered difficult to apply in daily life is no longer appropriate. Ethnomathematics itself can be used as a medium or approach in learning mathematics so that mathematics can be well understood by students. One of the mathematical activities that are integrated with the culture of the community is agricultural activities. The cultures that exist today are derived from agrarian culture, and if the agricultural culture system experiences problems such as destruction, it will lead to the destruction of the cultural system of human society, especially in the struggle for public property resources. Likewise in Indonesia, agricultural culture needs to be preserved to be in harmony with other community cultures [17].

Based on this background, researchers are interested and strive to implement Ethnomathematics learning in the context of oil palm cultivation using the Indonesian Realistic Mathematics Education (IRME) approach. IRME is a solution to lead students to the introduction of mathematical concepts and is seen to be able to bring changes to student understanding [18]. Ethnomathematics learning is more suitable to use because it is a realistic mathematics learning [19]. This is because Ethnomathematics itself contains the context needed for learning with IRME, while the context here is ethnic or local culture [15].

There are several similar studies that look at aspects of flat field and Ethnomathematics [20 - 22]. In the implementation of inquiry learning with Ethnomathematics, with the subject of planes (square and rectangular) to comprehend students' mathematical understanding abilities, concluded that further research on other topics is needed, specifically on other mathematical abilities by adjusting the culture that is relevant to the teaching material [15]. In the study of Ethnomathematics based RME, presenting class instruction and elements of Sundanese culture Ethnomathematics which is characteristic in the Regency Purwakarta is an alternative for teachers to give learning by linking between cultural elements with mathematics [20]. In the study using qualitative research with ethnographic approaches and the

instrument in this study is the human instrument. The results of this study in the form of mathematical concepts contained in the Madura Batik motif are: straight lines, curved lines, parallel lines, symmetry, points, angles, rectangles, triangles, circles, lines and the concept of congruence [21].

The difference between this research and other studies is that this study will examine Ethnomathematics in the context of oil palm cultivation in mathematics learning in junior high school flat field material using the IRME approach, with qualitative research methods. Because of all the aforementioned series of opinions and researches, the researcher intends to conduct a study entitled "Ethnomathematics-based learning using oil palm cultivation context".

From the problems that have been formulated, this research aims to: 1) Finding mathematical ideas contained in oil palm cultivation. 2) Implement Ethnomathematics from the context of oil palm cultivation into mathematics learning in schools. 3) Knowing students' responses in Ethnomathematics based learning in the context of oil palm cultivation.

2. Method

This study uses descriptive qualitative research methods. The subjects in this study were students at grade seven, SMPN 4 Muara Enim. In accordance with the characteristics of the data needed in this study, data collection techniques used are: 1) Observations made in qualitative research, observations used are direct observation. Direct observation in this study is used to reveal data about the process of forming students' characters. 2) The type of interview used in this study is structured interviews. Researchers conducted interviews with oil palm companies and several SMPN 4 students in Muara Enim who were considered capable of providing the information needed. The documents used in this study are a list of research respondents, photos of students in the learning process in class, video interviews with several students.

The data analysis in qualitative research was carried out at the time the data collection took place, and after the data collection was completed after the data collection was completed within a certain period. At the time of the interview, researchers have done an analysis of the answers interviewed [23]. If the answers interviewed after being analysed were not satisfactory, then the researcher would continue again to a certain stage until data was deemed credible. In addition, activities in qualitative data analysis are carried out interactively and continue continuously until completion [23].Qualitative research is a type of research whose findings are not obtained through statistical procedures or other forms of calculation [24].

3. Result and Discussion

3.1. Ethnomathematics-based Mathematics Learning

Ethnomathematics is only relevant for mathematics learning in the realm of school mathematics, and describes the findings as follows [25]:

a. Ethnomathematics-based mathematics learning is in harmony with the nature of school mathematics: (1) mathematics as a search for patterns and relationships; (2) mathematics as creativity requires imagination; (3) mathematics as a problem solving activity, and; (4) mathematics as a style of communication.
b. Ethnomathematics-based mathematics learning is aligned with the nature of students learning mathematics. In order for the potential of students to be developed optimally, the assumptions and implications could be used as references are: (1) students will learn if they get motivated; (2) the way students learn is unique; (3) students learn mathematics through collaboration, and; (4) students need different contexts and situations in their learning [15].

Thus, in this ethnomathematics-based learning research the researcher uses the IRME approach to the context of oil palm cultivation, while the IRME characteristics are, the use of the context, the use of the model, the utilization of student construction results, interactivity, and the relationship [26].

3.2. Mathematical Idea

According to the results of preliminary observations it can be seen that the activity of oil palm cultivation there is mathematical activity that appears. The mathematical activities include counting, measuring and calculating. The activity is in the stages of oil palm cultivation.

The measuring activity arises when the farming community chooses the pattern of planting oil palm spacing. Farmers usually determine the distance cropping polat first before determining how many seeds are needed. Spacing is used to determine the number of plants per unit area.

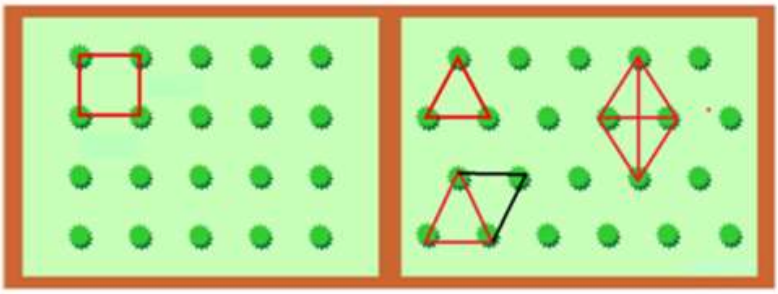

Figure 1. Sketches of rectangular and triangular patterns in oil palm cultivation.

Based on Figure 1, in Indonesia there is a special way to plant oil palm and plant spacing and determine the number of seedlings with a triangle pattern and a rectangular pattern. Each pattern has a different planting distance. To determine the spacing of triangular patterns and rectangular patterns students can apply the concept of a flat plane.

Spending activity arises among the community planting oil palm seedlings. This activity appears after selecting the type of spacing pattern used. The counting activity arises when the farmer already knows the spacing pattern used that is adjusted to his land area, after that the farmer can calculate how many seedlings are needed, so finding a formula to determine the number of seedlings as follows:

$$\text{Number of seeds} = \frac{\text{land area}}{\text{planting distance}}$$

3.3. Students' Responses to Palm Oil Cultivation Ethnomathematics in Learning Flat Field Materials

Students' responses is classified by student's level of cognitive ability, namely high cognitive students, moderate cognitive students, and low cognitive students. The analysis will be conducted on students' performance on learning and understanding the material as well as learning media.

3.3.1. Analysis of responses possessed by high cognitive students.

a. Learning and understanding the material

Based on Figure 2 the results of the analysis of learning and understanding of material high cognitive students meet all the response indicators, namely cognitive students feel happy with the way that teachers apply mathematics learning using the context of oil palm cultivation, high cognitive students are able to understand concepts and solve flat field material problems using context oil palm cultivation, and students are motivated to study mathematics.

Figure 2. High cognitive student responses to Ethnomathematics based learning.

b. Media
Based on Figure 3 the results of the analysis of the test sheet it is known that when working on the subject matter raises the following response indicators: with the presence of worksheet students are helped in learning and understanding flat field material, students can work on questions in worksheet with group discussions and are able to work on problems with their own abilities, and cognitive students high has its own way of solving problems in a fast way (can be seen in the results of the answer).

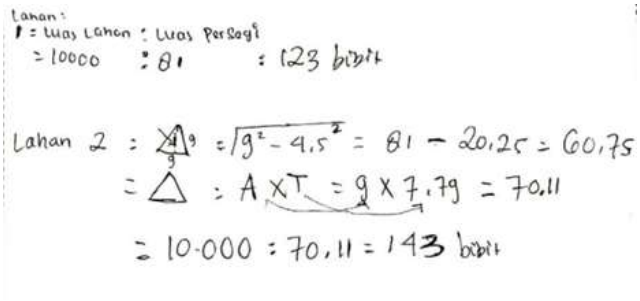

Figure 3. Results of high cognitive student answers.

3.3.2. Analysis of Responses Possessed by Moderate Cognitive Students

a. Learning and understanding of the material
Based on Figure 4, the results of the analysis of learning and understanding of material cognitive students are fulfilling all the indicators of response to feel happy about the way the teacher applies mathematics learning using the context of oil palm cultivation, able to understand concepts and solve flat field material problems using the context of oil palm cultivation, and students are motivated to learn mathematics even though initially cognitive students are causing a lot of gestures that show expressions of difficulty in solving problems, cognitive students are also asking for help from their friends to understand him and his friends respond well, and cognitive students are still not understanding, then the teacher start approaching the student and ask where the difficulty is, then the teacher gives an explanation of the difficulties experienced by the cognitive student being, and the student starts working and shows a happy expression of being able to finish his work.

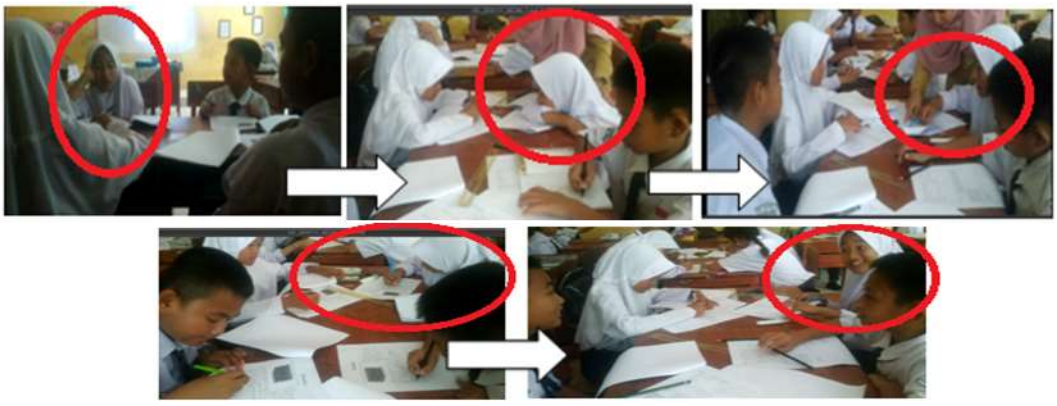

Figure 4. Student responses are being towards Ethnomathematics based learning.

b. Media
Based on Figure 5 the results of the analysis of the test sheet it is known that when working on the subject matter raises the following response indicators: with the presence of worksheet students are helped in learning and understanding flat field material, students can work on questions in worksheet with group discussions and are able to work on problems with their own

abilities, and cognitive students is having his own way of solving the problem, on land A he immediately divides the area of land at square plant spacing, while on land B he looks high on the triangle pattern first using the Pythagoras method, and uniquely then he finds the spacing of triangular pattern using the area of the longline.

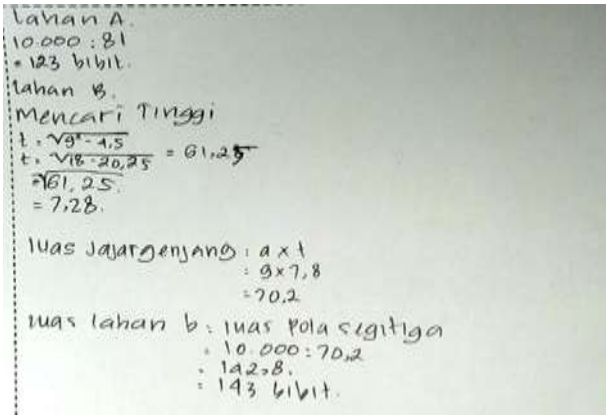

Figure 5. Results of moderate cognitive student answers.

3.3.3. Analysis of Responses owned by low cognitive students

a. Learning and understanding the material

Based on Figure 6 the results of the analysis of learning and understanding of material low cognitive students feel happy about the way the teacher applies mathematics learning using the context of oil palm cultivation, able to understand concepts and solve flat field material problems using the context of oil palm cultivation, and students are motivated to learn mathematics, although at first the student showed gestures that seemed to dislike the material, but during the discussion he showed that he wanted to know by asking friends of his group, and finally could solve the problem himself, even he was confident to present the answer in front class of his own accord (Figure 6).

Figure 6. Low cognitive student responses to Ethnomathematics based learning.

b. Media
Based on Figure 7 the results of the analysis of the test sheet, it is known that when working on the subject matter raises the following response indicators: with the presence of worksheet students are helped in learning and understanding flat field material, students can work on questions in worksheet with group discussions and are able to work on problems with their own abilities, something interesting In a low cognitive way, he found the number of palm seedlings in the first B field by using Pythagoras after getting the results, he immediately multiplied the results by 9.

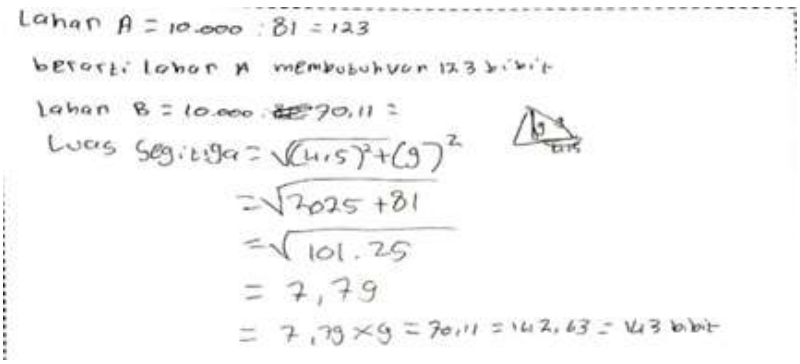

Figure 7. The results of low cognitive student answers.

Based on the results of the study indicate that Ethnomathematics based learning in the context of oil palm cultivation has a positive response from students in the flat field material to students' problem solving abilities. The results of this study are in line with research conducted by Kiptiyah concluding that there is a significant influence of students' interest in learning and problem solving skills on problem solving abilities, and students have positive responses to the learning tools developed [27].

4. Conclusion

Research on flat field learning using ethnomathematics-based oil palm cultivation contexts yields the following conclusions:1) The development of Ethnomathematics-based learning tools can provide solutions to mathematics teachers to innovate mathematics learning, 2) The development of Ethnomathematics-based learning tools can be combined in the IRME approach, and Ethnomathematics learning, 3) The resulting product is in the form of a Learning Implementation Plan and a Student Activity Sheet, and the device is combined with a IRME approach, and Ethnomathematics learning, 4) Mathematics learning based on Ethnomathematics in junior high can improve the cultural values and national character of students, 5) Ethnomathematics-based mathematics learning in junior high can improve students' mathematical problem solving abilities.

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