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Ethnomathematics Exploration in Modulo Learning in Bekles Ball Games

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ABSTRACT

The purpose of this research is to explore the relationship between Modulo Learning and the traditional game of bekles ball. The Bekles Ball Game is a traditional game which is a cultural heritage that is increasingly being played by today's generation of children. In order to keep the Bekles Ball Game maintained and not forgotten, there is one way that can be done, namely by applying it to the learning in the classroom so that this is the aim of this research. The Bekles Ball game is in fact related to Modulo Learning. This study used qualitative research with 2 informants from Class X-TKJ at SMK Nusantara Lubuk Pakam. The data collected is from the results of observations, interviews and in the form of documentation. In this study, the concept of division was used in Modulo 10 and Modulo 8. Based on this research, it can be seen that there is an ethnomathematics value in the bekles ball game which refers to learning the concepts of Modulo 10 and Modulo 8. It can be concluded that there are many ethnomathematics changes that we can do that can be used to learning media as an exploration of ethnomathematics.

Keyword : Eksplorations, Ethnomathematics, Modulo, Bekles Ball Games

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1. INTRODUCTION

Mathematics is a subject that exists at every level of education, from elementary school, junior high school, high school/vocational school even to the university level. Mathematics, which is synonymous with calculations and formulas, is a frightening specter for today's students. Even though in reality learning mathematics is not that scary. In this case, the teacher's role is really needed to change the mindset of students about scary mathematics, namely in a creative and appropriate way in determining the media used in the process of teaching and learning activities.

In this study, researchers will try to explore ethnomathematics in the learning process. Ethnomatematics consists of combining the words "ethnic" and "mathematics" which means teaching that combines ethnicity or culture into learning mathematics[1]. In this case learning activities can be combined with traditional games that match the mathematics material being taught. For example, the congklak game as a medium for addition, subtraction, multiplication and division, then the crank game which can be used in learning geometry and many more traditional games which can be explored with learning mathematics.

Related research on the exploration of traditional games has started to do a lot of research. In the traditional maggurenceng game, ma'belle has been studied as a source of student learning [2]. Apart from that, the traditional games of congklak and snakes and ladders have also been studied [3] and brought major changes to the process of learning mathematics. There are also various kinds of traditional games that have been researched by traditional game group teams [4] which have opened the mindset that there are many traditional games that can be explored in learning.

In this case the researcher will conduct research related to the traditional ball bekles game which is related to mathematical material, namely Modulo Concept Learning. Prior to this research, there was research that also discussed traditional games that discussed the concept of modulo [3], but researchers felt the need for research development related to the concept of modulo to make it more specific.

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The traditional game that researchers use is the traditional ball bekles game. The Bekles Ball Game is a game that originates from the Central Java region and has spread to various regions in Indonesia. It is usually played by 2 to 5 people. The procedures for playing bekles ball are as follows:

1. Prepare one bekel ball and at least 10 bekel seeds.
2. All players negotiate to determine who is the first to play the bekel and so on.
3. Next, the first player does the initial session of the game. The bekel ball will be tossed into the air and continued by picking up all the bekel seeds before the bekel ball bounces on the floor 2 times. After that, immediately take back the bekel ball.
4. Then, the bekel seeds are again distributed and the ball is thrown into the air. While waiting for the ball to bounce, take one bekel seed and then catch the ball again. Do it until all the bekel seeds are used up.
5. The next session is still using the same technique, except that you have to take 2 bekel seeds, then 3, 4, 5, until 10.
6. If the player can still continue the game, then the player must turn the bekel ball to the bottom side. Do it one by one until all the bekel seeds face down and take the bekel seeds either one by one or several at a time.
7. The next session is carried out by turning the bekel seeds to the right and left. If all the bekel seeds are turned upside down, take them one at a time or several at a time, until all the bekel seeds are used up.
8. The player who is the first to complete the sequence of game sessions above, is the winner.

In the bekles ball game there are 2 levels of play, namely: Level one, when the player only takes the bekel seeds one by one, then followed by 2 seeds at a time, 3 seeds at a time and so on. It is at this level that we can associate the game of bekles ball with lessons in class, namely Modulo Concept Learning. Furthermore, players can enter the second level after successfully taking all the bekel seeds in one ball throw. For this second level, the player must turn the bekel seed upside down, right or left and take it back as in the first level. This Bekles Ball game looks very easy, but there are several rules that must not be broken in order to enter the next level, namely:

1. Bounce the ball should not be more than 1 time.
2. When you have entered the next session, for example taking 2 bekel nuts at once, then your fingers may not pick up the bekel nuts that will not be taken.
3. When you turn the bekel over and there is one of the bekel pieces that flips over to the other side, then the player can fall.

The three main rules for the bekel ball game above are the general standard for determining the winner of this traditional game. So if one of the rules above is violated, then the previous player is counted as a loser and must take turns with other players according to the order of the game

Based on the procedures and rules of the bekles ball game the researcher wants to conduct research in the form of exploring ethnomathematics in the bekles ball game which is explored by learning the Modulo concept. In this research, the researcher demonstrates the division operation on modulo ten and eight. This research aims so that learning mathematics does not become a frightening specter and can preserve cultural values in traditional games.

2. RESEARCH METHOD

The research design used in this study is an ethnographic research design with a qualitative research approach. The ethnographic method is a research procedure used to describe, analyze and interpret a pattern of language, behavior and culture [5]. The Qualitative Approach is a study that does not use statistical calculation processes or other calculations [6].

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The research subjects were two students of Nusantara Lubuk Pakam Vocational School who knew how to play bekles ball. The purposive sampling technique was carried out on the selection of research subjects with the provisions 1) knowing the game of bekles ball; 2) The subject performs a bekles ball game according to the provisions of the game; 3) The subject is included in the youth group. Based on these provisions, one subject was 15 years old and one other person was 16 years old. The object of the research is the rules in the bekles ball game and the bekles ball game.

The research was held at SMK Nusantara Lubuk Pakam on Jalan Tengku Raja Muda No. 01 Lubuk Pakam. The data collected is from the results of observations, interviews and in the form of documentation. In this study the analysis used was qualitative analysis so that the results were in the form of data reduction, data presentation and conclusions drawn.

3. RESULTS AND DISCUSSION

Based on the results of observations, interviews and documentation carried out, there was enthusiasm from students in exploring the game of bekles ball and in preserving culture in the form of learning the Modulo concept so that the ethnomathematics to be achieved was formed.

In the procedure for playing bekles ball, there are rules for taking bekles seeds. If associated with learning mathematics can be classified into learning the concept of modulo. In the procedure for taking bekles seeds there are rules written in Javanese, namely: Mi Hiji which means taking 1 bekles ball for every bounce of the bekles ball, if Mi Opat means taking 4 bekles seeds for every bekles ball bounce. In this study, there were two experiments, namely the experiment with 10 bekles and 8 bekles, where the results were as follows:

A. Bekles Ball Game with the 10 Modulo Concept

In learning the Modulo Concept, the 10 bekles used are 10 bekles. Where the concept of taking is Mi Hiji, Mi Dua, Mi Tilu to Mi Ten which have been summarized in Table.1. Where at the time of taking bekles seeds there is a mathematical concept, namely the remaining divisions that can be collaborated into learning mathematics, namely modulo 10 because it uses 10 bekles seeds.

Table. 1 Remaining Distribution of bekels Seeds to Number 10

Pengambilan	Pembagi	Sisa Pembagian
Mi Hiji (1)	1	0
Mi Dua (2)	2	0
Mi Tilu (3)	3	1
Mi Opat (4)	4	2
Mi Lima (5)	5	0
Mi Genep (6)	6	4
Mi Tujuh (7)	7	3
Mi Dalapan (8)	8	2
Mi Salapan (9)	9	1
Mi Sapuluh (10)	10	0

So that it can be used in such a way that equation (1) modulo is as follows:

$$\boldsymbol{x\ Mod\ y = z, so\ \ x = yq + z, 0 \leq z < y} \quad \textbf{(1)}$$

Where x is the number of bekles seeds, y is the number of bekles taken and z is the remainder of the division, so that in the concept modulo 10 it can be written 10 Mod y=z. In this study the results are as follows:

- 10 mod 1 = 0 - 10 mod 6 = 4
- 10 mod 2 = 0 - 10 mod 7 = 3
- 10 mod 3 = 1 - 10 mod 8 = 2
- 10 mod 4 = 2 - 10 mod 9 = 1
- 10 mod 5 = 0 - 10 mod 10 = 0

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The bekles ball game activities using modulo 10 are shown in Figure 1.



Figure 1. Bekles Ball Game with the 10 Modulo Concept

B. Bekles Ball Game with the 8 Modulo Concept

In learning the Modulo Concept, the 8 bekles used are 8 bekles. Where the concept of taking is Mi Hiji, Mi Dua, Mi Tilu to Mi Dalapan which has been summarized in Table.2. Where at the time of taking bekles seeds there is a mathematical concept, namely the remaining divisions that can be collaborated into learning mathematics, namely modulo 8 because it uses 8 bekles seeds.

Table. 1 Remaining Distribution of bekels Seeds to Number 10

Pengambilan	Pembagi	Sisa Pembagian
Mi Hiji (1)	1	0
Mi Dua (2)	2	0
Mi Tilu (3)	3	2
Mi Opat (4)	4	0
Mi Lima (5)	5	3
Mi Genep (6)	6	2
Mi Tujuh (7)	7	1
Mi Dalapan (8)	8	0

So that it can be used in such a way that equation (1) modulo is as follows:

$$\boldsymbol{x\ Mod\ y = z, so\ \ x = yq + z, 0 \leq z < y} \quad \textbf{(1)}$$

Where x is the number of bekles seeds, y is the number of bekles taken and z is the remainder of the division, so that in the concept modulo 8 it can be written 8 Mod y = z. In this study the results are as follows:

- 8 mod 1 = 0
- 8 mod 2 = 0
- 8 mod 3 = 2
- 8 mod 4 = 0
- 8 mod 5 = 3
- 8 mod 6 = 2
- 8 mod 7 = 1
- 8 mod 8 = 0

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The bekles ball game activities using modulo 8 are shown in Figure 2



Figure 2. Bekles Ball Game with the 8 Modulo Concept

4. CONCLUSION

Traditional games which are increasingly rarely played by the current generation have very good uses if used optimally, especially when used as learning media. In the research that the researchers did, there was an ethnomathematics value in the traditional bekles ball game, where researchers explored the bekles ball game by learning the concept of modulo. In the bekles ball game that the researcher did, there were seeds used where these seeds were meaningful as numbers and there was an addition operation.

Related to the modulo concept contained in the concept of division where the division occurs when the seeds in the bekles ball game are taken according to the provisions of the game. In this study the researchers used two experiments, namely on the sepulh bekles seeds and the eight bekles seeds. The results of the division that refer to the remainder of the seeds are obtained and students can determine them in the form of modulo ten and modulo eight.

In this case it turns out that there are ethnomathematics values seen in exploring learning on the modulo concept. Based on the results of this study, it can be used as an example and used as a learning media in class that can be used in addition to learning activities and can also increase love for our culture. It is hoped that further researchers can develop other ethnomathematics as teaching materials, teaching media can even become student worksheets.

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