Exploration of Ethnomathematics of *Hadrah* Musical Instruments as an Exam Material for Elementary School Students

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Abstract: Ethnomathematics is a science used to understand how mathematics is adapted from culture. This can help students understand mathematical concepts while learning about the culture of the surrounding environment. This study aimed to describe ethnomathematics on hadrah musical instruments and make an exam kit. This is a qualitative research with an ethnographic approach. Data collection methods used were observation and interviews. The subjects of the study were a craftsman and a hadrah musical instrument player. Ethnomathematics on hadrah instruments include tambourine, jidur, dumbuk, and keprak. The results of research showed that tambourine and keprak musical instruments have mathematical elements namely frustum of a cone and concept of a circle. In jidur instrument, there were mathematical elements namely frustum of a cone, circle, and congruence. In dumbuk musical instrument, there were mathematical elements of congruence, and the combination between tube and frustum of a cone. The exam kit is a tool for knowing and evaluating students' learning outcomes in which it has exam content outline, exam questions, answer sheets, answer keys, and assessment rubrics. The exam kit made in this research was a collection of geometric material questions about plane and solid regarding ethnomathematics in hadrah musical instrument.

Keywords: Ethnomathematics, Hadrah Musical Instrument, Exam Kit

1. INTRODUCTION

Ethnomathematics is a science used to understand how mathematics is adapted from a culture that functions to show the relation between culture and mathematics (Marsigit, 2016). According to Balitbang (in Suharta, et al. 2017) mathematics is used in various aspects of life, mathematics is close to daily life. In any case, mathematical knowledge is always used, habits or daily activities are laden with mathematics. The whole system of thoughts, values, moral, norms, and beliefs of human society is culture. Mathematics can be obtained from culture so that ethnomathematics in mathematics learning can be used as a concrete mathematics teaching material and provides a new atmosphere for students that mathematics is not difficult and can be found in the environment around students because mathematics and culture are interrelated. Indonesia is famous for its cultural diversity. One of the developing cultures in Indonesia is the art of hadrah music. Sinaga (2006: 1) mentioned that tambourine as one of the medium for preaching. Tambourine art activities are present from a variety of recitation group activities, activities of commemorating Islamic holidays, tasyakuran (activities for giving thankfulness), walimatul urusy (celebration on marriage), walimatul khitan (celebration on circumcision), walimatul hamli (celebration on pregnancy), and other celebrations. In this hadrah art, the poetry and tambourine wasps are sung.

Hadrah art is one of the traditional Islamic music arts that existed since several centuries ago along with the entry of Islam into Indonesia. Tambourine is a musical instrument played by hitting it with a hand. Different ways of hitting produce different sound characters. Other hadrah instruments include tambourines. *iidur*, and *dumbuk* have different shapes so that besides having religious values, they also have mathematical values because they use the basic concepts of geometry in their ways of making, such as circle, tube, and cone and even the combination of both. Based on the research that has been done previously, there is a concept of one-dimensional, two-dimensional, and three-dimensional geometry which is found in the form of circle, frustum of a cone, and tube in hadrah instrument. The research has been proven by Ramadhani (2019). The research of Putri (2017) stated that in hadrah musical instrument, there were mathematical concepts of plane and solid in the form of circle, tube, and cone.

Based on this explanation, this research was conducted to answer the questions" "what are ethnomathematics on hadrah musical instrument?" and "what is elementary school student exam kit as a product regarding ethnomathematics on hadrah musical instrument?".

2. RESEARCH METHOD

This used qualitative research with ethnographic approach. This research was conducted through observation

and interviews. There were two subjects in this study, namely a *hadrah* musical instrument craftsman in Balung village, Jember Regency, and a *hadrah* musical instrument player who is also a student at Al-Jauhar Student Islamic Boarding School, Jember. Data collection methods used were observation, interview, and documentation. Data analysis of the instrument validation results was carried out to test the validity of the research instrument. The research instrument was validated by two validators who are lecturers in the Mathematics Education study program, and an elementary school teacher.

In this study, the validated instruments were the observation guidelines and the interview guidelines. According to Azwar (in Hendriyadi, 2014), the formula proposed by Aiken's to determine the validity level of the instrument is as follows:

$$V = \frac{\sum_{i=1}^{2} s_i}{n (c-1)} = \frac{\sum (r_i - l_0)}{n (c-1)}$$

3. RESULT AND DISCUSSION

Based on the results of data analysis, it can be obtained several elements of ethnomathematics in *hadrah* musical instruments, namely plane and solid. This research focused on tambourine, *jidur*, *dumbuk*, and *keprak*.

Ethnomathematics on tambourine has mathematical element namely the frustum of a cone in tambourine and circle in the skin pattern of tambourine; meanwhile, the curvilinear area which is on the shape of the tambourine is not included in the discussion because it has not been taught at the elementary school level. This is in line with the research conducted by Andarini (2019) in which the results of the study stated that the geometry concept of the frustum of a cone shape was found to be in *bonang* musical instrument which has a geometry concept similar to tambourine.







Fig. 2. Illustration of General Geometry Shape on Tambourine

Jidur has mathematical elements specifically frustum of a cone and congruence; while the shape of ball in *jidur* hitting instrument is not included in the focus of this

research discussion. The congruence lies in the shape of the cone which is a complete shape of the frustum of a cone. Likewise, it is also in the research done by Lubis et al. (2018) showing that mathematical element was found especially the geometry concept of frustum of a cone shape in *gordang sambilan* musical instrument.



Fig. 3. Illustration of Shape on Jidur



Fig. 4. Illustration of General Geometry Shape in Jidur

Dumbuk is like a cup and has mathematical elements namely the combination of two frustum of a cone shapes. The frustum of a cone is a cone whose upper part is cut by a plane so that the shape of the cone is incomplete. The congruence is in the shape of the cone which is a complete form of the frustum of a cone. The frustum of a cone is included in three-dimensional geometry. This can be linked to the research of Putri (2017), in which the study showed that in *dumbuk* musical instrument, there were mathematical elements of the geometry concept of tube and cone.



Fig. 5. Illustration of Shape on Dumbuk





Fig. 6. Illustration of General Geometry Shape on Dumbuk

Keprak has the same mathematical elements as a tambourine namely frustum of a cone, curved plane, and circle. The difference is that *keprak* is smaller than tambourine. The frustum of a cone is in the shape of *keprak* and the circle is in the skin pattern on *keprak*; meanwhile, the curved plane found in the shape of *keprak* side is not included in the discussion because it has not been taught at the elementary school level. This is in line with the research of Wahyu (2018) which revealed Mandara Giri Semeru Agung Temple which is a place of worship for Hindus to have a mathematical element of geometrical concept of solid figure.



Fig. 7. Illustration of Shape on Keprak



Fig. 8. Illustration of General Geometry Shape on *Keprak*

Based on the research results that has been linked to the relevant researches, a primary school student exam kit was made. The exam kit is a tool for knowing and evaluating students' learning outcomes. In this exam kit, it contains mathematical concepts, namely calculating the area and circumference of a circle, calculating the area, and the volume of solid figure on *hadrah* instrument. One of the examples of an exam kit used is as follows.

1. Mr. Edi has a rectangular sheet of skin with a length of 50 cm and a circumference of 156 cm. If he is going to make a tambourine skin, what is the maximum circumference and area of the circle that Mr. Edi can make?



Fig. 9. Goat Skin in Rectangular Shape

2. Mr. Tono is a *keprak* maker. He will decorate his artificial *keprak* by surrounding the edge of the *keprak* with a tape. What is the length of the tape needed if Mr. Tono's *keprak* has a circle area of 314 cm²?



3. Deni likes to play *jidur* musical instrument. He will paint the *jidur* he has as in Figure 11. What is the area of *jidur* surface (shaded area) that Deni will paint?



Fig. 11. Jidur

4. *Dumbuk* is one of the unique forms of *hadrah* musical instrument. The shape of *dumbuk* is the combination between a tube and a frustum of a cone. What is the volume of *dumbuk*?



Fig. 12. Dumbuk

5. Mr. Banu has a tambourine, but the skin of the tambourine in a circle shape is removed. Mr. Banu will fix it by installing nails around the tambourine with a distance of 2 cm between each other. How many nails

are needed if Mr. Banu's tambourine has a circular area of 616 cm^2 ?



Fig. 13. Tambourine Nails

This is in accordance with Ramadhani's research (2019) which showed that in *hadrah* musical instrument, there were one-dimensional, two-dimensional, and three-dimensional geometry concepts which are found in the form of circle and frustum of a cone on *hadrah* instrument. Putri (2017) argued that in *hadrah* musical instrument, there were mathematical concepts of plane and solid figures in the form of circles, tubes, and cones. The researches are still limited to exploring the mathematical elements in *hadrah* musical instrument, but they have not made the results into a student exam kit.

4. CONCLUSION

Based on the results of data analysis and discussion, it can be concluded that there are mathematical elements in hadrah musical instrument. In tambourine and keprak musical instruments, there are mathematical elements namely the shape of frustum of a cone, a curved plane, and a circle. In *jidur*, there are mathematical elements of solid figure namely frustum of a cone, congruence, and ball. Besides, in *dumbuk*, there are mathematical elements of solid on the combination between tube and frustum of a cone, and congruence. The results of this analysis are used as material for making student exam kit. This exam kit contains questions on mathematical concepts, namely calculating the area and circumference of a circle, calculating the area, and the volume of the solid figure on hadrah instrument. In the exam kit, there are exam content outline, exam questions, answer sheets, answer keys, and assessment rubrics.

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