The Development of Geometrical Learning Devices Based On Rumah Gadang Ethnomathematics for Grade VII Junior High School

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Abstract. Based on the observations, interviews and preliminary analysis conducted in several schools, it showed that the learning devices used so far have not been linked to the culture around the students. Besides, the students’ learning outcomes were also still low. This was caused by (1) the learning resources that were still general in nature and not yet associated with the students' daily lives, (2) the student worksheet (LKPD) used so far did not contain sufficient activities for learning mathematics, (3) the LKPD contained problems that were difficult for the students to imagine, and (4) the activities in the lesson plan did not show the activities that lead the students to be active and can find their own mathematical concepts. Based on these problems, the researcher developed the Rumah Gadang ethnomathic-based geometrical learning devices in form of lesson plan (RPP) and LKPD. This study was a research and development conducted with the Plomp development model. The result of the study show that RPP and LKP was valid and practical.

1. Introduction

Education is an effort that is done consciously and planned in developing the students’ potential optimally. The goal is that students have a system of thinking, values, moral, and also beliefs in accordance with what has been inherited in the community. The inheritance is then developed in a way that is relevant to present and future life. This is in accordance with the philosophy in the development of 2013 Curriculum, namely: 1) education in the culture of the nation to build the lives of the future and future nations, 2) the students are the heirs of the nation's creative culture [1].

Mathematics is a form of true culture that has been integrated into every aspect of people's lives wherever they are [2]. However, the assumption that mathematics is final, permanent, absolute, unique and unrelated to culture still exists. Therefore, teachers must be able to show students that mathematics has a close relationship with culture and everyday life. Rumah Gadang is very possible to be used as a context in learning mathematics because in the design and philosophy of architecture there are many mathematical concepts. Based on the results of a study done by Fitriza, there were four concepts that can be obtained based on the exploration of Rumah Gadang Ethnomateica: lines and angles, flat
shapes, circles, and transformations [3]. Based on the results of this study, the researcher was interested to realize the mathematical concepts of Rumah Gadang into learning devices.

Based on observations and interviews with mathematics teachers conducted at SMP Negeri 3 and SMP Negeri 4 Padang, it was known that the language used by teachers in the learning process was still the teaching material provided by the government such as the K13 books published by Ministry of Education and Culture revised in 2016 and 2017, and mathematics books published by Erlangga, both K13 and KTSP. It also showed that the teaching material used by teachers was still a general nature. Meanwhile, available textbooks generally encourage teachers to teach mathematics mechanically and algorithmically [4], [5]. Based on the analysis conducted on the textbooks, RPP, and LKPD used at school it was known that both the contents of the book, RPP, and LKPD did not include the relationship between mathematics and the local culture.

Based on the results of the interview, the Minimum Completion Criteria (KKM) set by the school which was 72, more than 50% of the students did not reach the KKM. This fact can be seen in Table 1.

**Table 1.** The mean of the mathematics daily test results in Semester 2 of students grade vii SMP N 3 Padang in 2019/2020 academic year

| No | Class  | Average Score |
|----|--------|---------------|
| 1  | VII-1  | 54.37         |
| 2  | VII-2  | 70.41         |
| 3  | VII-3  | 58.37         |

Source: mathematics teachers at SMP N 3 Padang

Based on Table 1, it can be seen that the mean of the results of all classes was still below the KKM. This proves that learning objectives have not been reached to the maximum. Therefore, to achieve the desired competencies and to integrate culture in the learning process to run properly requires an effort in learning by creating a learning atmosphere that is close to the surrounding environment. One alternative learning approach that can achieve the desired results is through the ethnomatematics approach.

Ethnomatematics approach was chosen because they can integrate culture with mathematics. Ethnomatematics approach is defined as the use of a near and direct environment of a teacher in teaching mathematics [6]. In the learning process, Ethnomatematics has been proven to be able to increase motivation, mathematical ability of students, and overcome the needs and difficulties of students in learning mathematics [7], [8].

Mathematics is an activity that must be linked to the reality of life [9]. In the context of RME which is meant by the reality of life does not only show a mathematical relationship with the real world, but it is more an imagined situation, suitable, and real in the students’ minds [10],[11]. This is in line with ethnomathematics where in teaching mathematics the teacher uses an environment that is close, direct and can be imagined by students. The use of LKPD with the ethnomatematics approach in the learning process is expected to be able to integrate the daily culture of the students, especially Rumah Gadang, into the mathematics learning process and help achieve the high competencies.

Based on the problems outlined above, the researcher conducted a study on "The development of geometrical learning devices based on rumah gadang ethnomathematics for grade vii junior high school".

2. Materials and Methods

This study was a research & development that attempt to develop and validate products that will be used in education [12]. In this study, the researcher used the Plomp development model, many researchers have been use the Plomp model in developing mathematics teaching materials ranging from elementary school to college [13-23]. The product developed was a lesson plan (RPP) and student worksheet (LKPD) based on Rumah Gadang ethnomathematics. The Plomp development model has three stages,
namely the initial investigation phase, the development phase or the prototyping phase, and the evaluation phase [5]. The reason the researcher chose the Plomp model was because this model has simple and clear steps, so it is easy to be conducted compared to other development models.

The subjects of the trial of this Rumah Gadang ethnomatematics-based LKPD were the students grade vii of SMP N 3 Padang. The data in this study were obtained directly through the research instruments. The first data were obtained from the LKPD validity test by the validator. The second data were obtained on the implementation of the LKPD. The data consisted of validity and practicality test data.

3. Results and Discussion

At preliminary analysis, the needs analysis, curriculum analysis, concept analysis, and student characteristics analysis were conducted. Based on the needs analysis, it was found that in mathematics learning so far, the students have not constructed their own abilities in finding the concepts; the students were given formulas then completed examples using the formulas given and continued with exercises. Based on the curriculum analysis, it was found that the indicators to be studied were about finding the concept of flat shapes (rectangles and triangles). Then, based on the concept analysis, it was found that the prerequisite material that the students must master was lines and angles. Based on the results of the preliminary analysis, geometrical learning devices based on rumah gadang ethnomathematics was designed.

Self-evaluation is called as an evaluation conducted on the devices that are done alone. The activities carried out by looking back at the results of the design of the devices and correct the mistakes. Generally, many mistakes occured in typing words and punctuations. For example, a mistake in writing the word "di" for the description of place the space is written; it should be given a space, for example "di atas" should be written "di atas", "disamping" should be written to be “di samping”. In addition, there were also many mistakes in other typings. For example, using capital letters, the word “sehingga ananda akan” (“so you will”) was written on the device “sehinggaAnandaakan” (“soYouwill”). The mistakes in typing the LKPD before and after the revised evaluation results themselves can be seen in Figure 1.

| Before Revision |
|-----------------|
| ![Before Revision Image](image1) |

| After Revision |
|----------------|
| ![After Revision Image](image2) |

**Figure 1.** The Results of LKPD Revision in the Self-Evaluation Stage

The validity test of ethnomathematics-based learning devices was conducted by 5 lecturers come from 3 areas of expertise, namely educational technology, Indonesian Language, and mathematics. The mean of the validity test results of the RPP for each aspect was 3.81 which was in the very valid criteria. Overall, the RPP that have been developed were in very valid criteria. Thus, it can be concluded that the ethnomatematics-based RPP is valid. Meanwhile, the mean of the validity test results of the LKPD was 3.66 which was also in the highly valid criteria.
At one to one evaluation, LKPD was tested on 3 students to try to do the LKPD. The three students came from grade vii-3 of SMP N 3 Padang who had different abilities: 1 student with high ability, 1 student with medium ability, and 1 student with low ability. Each student was asked to pay attention to the presentation of the LKPD, tried to work LKPD according to their understanding of the problems, pictures, orders and questions that exist in the LKPD and asked to comment on the LKPD. This individual evaluation was carried out at 8 LKPD. The activities carried out were observing the instructions that were difficult for the students to understand in the LKPD and recording the responses, suggestions, sentences presented difficult to understand and students' questions about the LKPD.

In Figure 2 below, it can be seen that the students solve these problems by presenting what information is known and asked based on existing problems, then the students make a mathematical model of the picture of Rumah Gadang Ethnomathematics picture in the form of a diamond, then the students follow the completion steps in the Rumah Gadang Ethnomatematics-based LKPD so that the students are able to construct their understanding to find the concept of the circumference of rhombus.

**Figure 2. The Examples of the Students’ Answers in the one to one evaluation**

A small group evaluation was carried out eight times to see the practicality of the learning devices. The trial was conducted on the six students grade vii SMP N 3 Padang. The six students were divided into two groups with heterogeneous abilities. At meeting 1, the students were asked to follow up on their findings when exploring Rumah Gadang to find the properties of a rectangular flat figure. The examples of the students’ answers can be seen in Figure 3.
At the second to the eight meeting, the learning devices have used the contextual problems related to the Ethnomatematics of *Rumah Gadang*. The examples of the contextual problems at meeting 2 can be seen in Figure 4.

At the second meeting, the students seemed to be able to solve the problems that exist in the LKPD even with the help and questions of the researcher. The following examples of the students’ answers to get the concept of the circumference of square can be seen in Figure 5.

Based on observations and interviews conducted with the students, the results showed that in terms of the time efficiency according to the students, the time to do the LKPD was enough. Furthermore, in terms of the implementation, the students were able to use the LKPD quite easily, although there were still questions arising while working on the LKPD. The presentation aspect of the LKPD has been interesting with the problems in daily life, although initially the students found it
difficult because they had never solved the problem of the story related to Rumah Gadang but the students seemed enthusiastic to try it.

In the small group evaluation, the teachers and students were also asked to fill out the questionnaire that has been provided to see the practicality of the learning devices based on Rumah Gadang ethnomathematics. The summary of the practicality results from the students was presented in Table 2, While The mean score from questionnaires of Rumah Gadang ethnomathematics-based was 88.46 (very practical). In Table 2, the mean results of the student practicality questionnaire were 88.54 in the very practical category.

| No. | Assessed Aspect   | Average   | Criteria       |
|-----|-------------------|-----------|----------------|
| 1   | Legibility        | 83.33     | Practical      |
| 2   | Presentation      | 88.19     | Very Practical |
| 3   | Easy of Use       | 90.97     | Very Practical |
| 4   | Time              | 91.67     | Very Practical |
|     | The Overall Average | 88.54     | Very Practical |

4. Conclusion
Based on the results of the study, it can be concluded that the development of the learning devices (RPP and LKPD) based on the Rumah Gadang Ethnomathematics were valid and practical. Thus, the researcher gives a suggestion to develop the RPP and LKPD based on the Rumah Gadang Ethnomathematics on other mathematical material that can contain the context of the Rumah Gadang Ethnomathematics.

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