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Exploration of Ethnomathematics at *Rumah Gadang Minangkabau* to Design Mathematics Learning Based on RME in Junior High Schools

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ABSTRACT

In the Rumah Gadang Minangkabau architecture, various aspects of Ethnomathematics can be raised as real and exciting mathematics learning topics. These aspects have not been well explored and documented. This study aims (1) to explore the mathematical ideas contained in the construction and design process of the Rumah Gadang Minangkabau, (2) to design mathematics-learning tools based on realistic mathematics education (RME) sourced from Ethnomathematics at the Rumah Gadang Minangkabau. The study uses a combination of ethnographic and design research. Ethnographic research has explored Ethnomathematics in building and designing a Rumah Gadang in Minangkabau (covering *Darek*, coastal, and *Rantau* areas). Data collection techniques at this stage: in-depth interviews with key informants (Senior Builder, Carvers, *Ninik Mamak*, Traditional Leaders, and others.), observations, and manuscript analysis. The identified ethnomathematics aspects are integrated into the RME-based learning tool using design research, consisting of a preliminary phase, a prototyping phase, and an assessment phase. The RME-based learning design prototype has been validated by several experts (RME and Ethnomathematics experts, learning technology, and languages), and practitioners through focus group discussion (FGD) activities. Furthermore, the learning design was evaluated formatively (one to one and small group) to investigate its practicality. The collected data were analyzed using descriptive and inferential statistics.

Keywords: *Ethnomathematics, Rumah Gadang Minangkabau,RME.*

1. INTRODUCTION

Minangkabau is an affluent area in culture and customs. One of the unique elements of Minangkabau culture is the Rumah Gadang. Rumah Gadang building construction is unique and exciting. The shape is big upwards, almost like a boat. It is because the poles are erected at a 91° - 94° slope. The Rumah Gadang is determined by the amount of space (long section) and *lanjar* (width section). The length of the Rumah Gadang generally varies between 3, 5, 7 to 9 spaces (odd numbers). Besides, the connecting devices between one and another are pegs and pins, made of wood [1], [2].

From the preliminary study, many elements of Ethnomathematics were found in the design of the Rumah Gadang. The search results [3] and [4] show that the elements of Ethnomathematics are also found in the Rumah Gadang design, structure, and construction process. Ethnomathematics elements in the Rumah Gadang are very likely to become an exciting context in learning mathematics. Those, in the design and architectural philosophy, there are various mathematical concepts. [5] Moreover, [6] reveal the many symmetrical concepts in the carvings in the Rumah Gadang.

Considering that each area in Minangkabau, which includes 'darek,' coastal and 'rantau' areas, has many Rumah Gadang with its peculiarities, it is deemed necessary to explore the Ethnomathematics contained in the Rumah Gadang. This exploration is carried out with three main objectives. First, preserve the elements and cultural values in the design, structure, and process of building a Rumah Gadang. The existence of the Rumah Gadang is threatened with extinction and is decreasing in number [7]. Due to age and maintenance factors that damage the Rumah Gadang, documenting the Ethnomathematics elements in the Rumah Gadang is very important.

The second, to provide scientific and empirical evidence to the world of education about the relationship between mathematics and culture, especially those found in the Minangkabau Gadang house. According to [8], mathematics is a form of culture. As a form of culture, mathematics has been integrated into all aspects of people's lives everywhere. Their cultural background influences a person's mathematics because they are based on what they see and feel [8]. Thus, the assumption that mathematics has nothing to do with culture is the wrong assumption.

The above description implies that teachers must show perceptions and attitudes that mathematics is closely related to culture and everyday life to know how to use mathematics in their lives [9]. Besides, [10] stated that mathematics is a human activity and must be related to life's reality.

Third, referring to the close relationship between mathematics and culture, the Ethnomathematics contained in the design, structure, and process of building a Rumah Gadang are believed to be an exciting and realistic context for students to be used as starting points in mathematics learning. Realistic mathematics education (RME) is a learning approach that makes context and contextual problems the main elements for starting mathematics learning.

RME context does not only show the relationship between mathematics and the real world (real world) but refers to situations that can be imagined (imaginable), suitable and real in the minds of students [11], [12]. The use of context in questions affects students' responses. Students themselves can provide the correct answer based on their daily lives [13].

The use of context in mathematics learning is also useful for students in establishing direct relationships between mathematical contexts and ideas to support students' development in mathematical thinking [14]. The context will lead students to understand mathematics from something real for students to become something formal that can be written with symbols through the mathematical stage [15].

In this study, the context provided in RME uses the ethnomathematics concept. The term ethnic refers to all the components that build a culture's identity, such as language, code, values, jargon, beliefs, food and clothing, habits, and physical characteristics [16]. Ethnomathematics is seen as a scientific discipline that combines the interrelationships of culture and mathematics.

Learning with the Ethnomathematics approach has been proven to increase motivation, the achievement of students' mathematical abilities, retention, and overcoming boredom and difficulties of students in learning mathematics [17], [18], [19]. Likewise, the use of cultural contexts in mathematics learning with the RME approach has increased the achievement of learning mathematics, critical thinking skills, and right character/attitude [20], [21], [22], [23], [24].

2. METHOD

The study uses a combination of ethnographic and design research. In essence, ethnographic research emphasizes documenting and describing individuals' daily experiences by observing and interviewing them [25], [26]. Through ethnographic research, Ethnomathematics will be explored in the process of building and designing Rumah Gadang in Minangkabau (covering *darek*, coastal, and *rantau* areas). Data collection techniques use participatory observation, in-depth interviews with key informants (Senior Builder, carvers, *Ninik Mamak*, Traditional holders, and others.), and documentation studies (manuscript analysis).

Data analysis was carried out before entering the field, during the field, and after completion. Data analysis was carried out in three steps: 1) data reduction/codification, 2) data presentation, and 3) concluding.

From the ethnographic research conducted, aspects of Ethnomathematics in the Rumah Gadang Minangkabau will be identified. These aspects will be grouped into five mathematical ideas: counting, measuring, locating, designing, playing, and explaining.

After the Rumah Gadang Minangkabau Ethnomathematics aspects are identified, an RME-based learning tool will be designed using a research design consisting of a preliminary phase, a prototyping phase, and an assessment phase [27]. Research activities at the preliminary stage consist of the curriculum analysis and concept analysis to integrate the five mathematical ideas. Based on the analysis results, the prototyping phase designed an RME-based mathematics learning design for SMP. Several experts (RME and Ethnomathematics experts, learning technology, and languages) and practitioners through focus group discussion (FGD) activities will validate the RME-based learning design prototype. Furthermore, the learning design will be evaluated formatively (one to one and small group) to investigate its practicality.

For formative evaluation of all products produced in this study, the steps proposed by Tessmer are used, as shown in Figure 1.

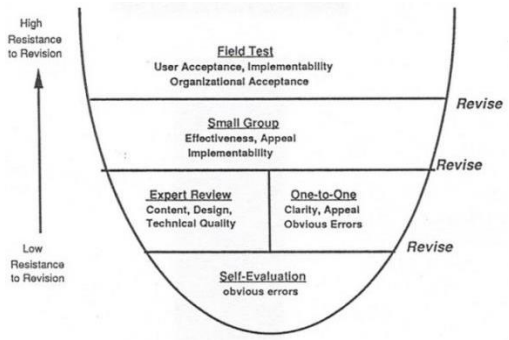

Figure 1 Formative Evaluation

3. RESULT AND DISCUSSION

Based on the exploration results, ethnomathematics aspects were identified in the Rumah Gadang, namely: 1) The idea of counting (associating objects into numbers) is on the stairs, and the number of space slopes the Rumah Gadang, which must always be odd, 2) The idea of measuring (comparing, predicting and calculating the quality) is found in the length of the room of a Gadang which is not always the same length and also the length of which is not always the same, 3) The idea of locating, (topography and cartography / spatial) is found in the selection the location of the Rumah Gadang building, 4) Designing ideas, (conceptual artifacts/ideas about shape) are found in the carvings in the Rumah Gadang and their meanings, 5) Playing ideas (procedures and rules) are found on the wood that forms the roof Gadang and Rumah Gadang stairs.

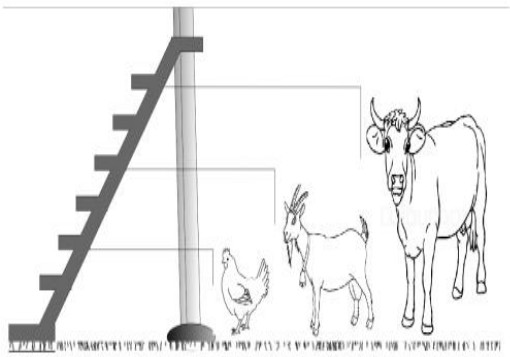

Figure 2 The Idea of Playing at the Rumah Gadang

The idea of playing on the number of steps in a Rumah Gadang is where the number of children must be odd, namely 3, 5, 7, or 9 steps. It is closely related to the house's function to raise chickens, goats, cows, or weaving places for women. 6) Explaining ideas (relating to the cognitive aspects of conceptualization and explanation of the concept).

After exploring the Ruma Gadang and obtaining the mathematical ideas contained therein, these ideas are integrated into mathematics learning tools based on realistic mathematics education (RME) on the topic of flat wakes. seen in figure 3

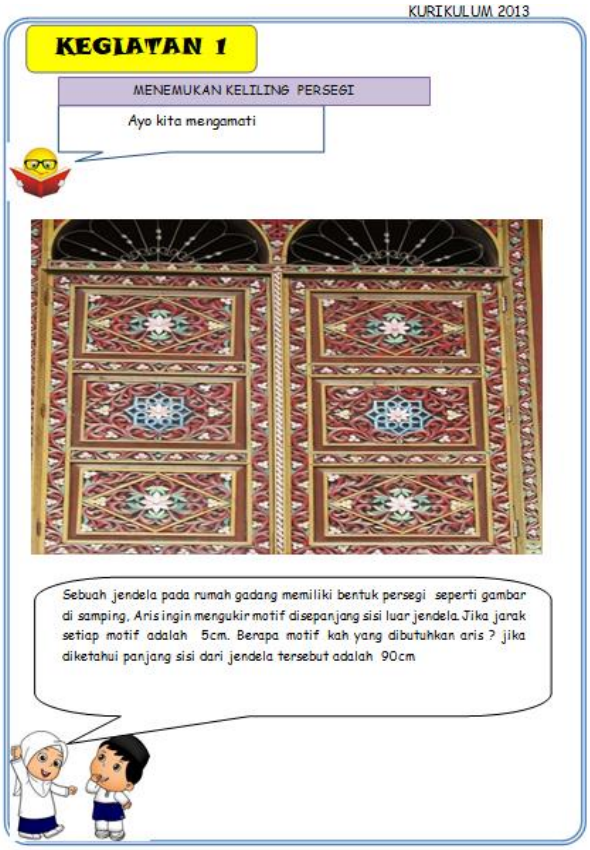

Figure 3 Example of Integrating Ethnomathematics based on RME Learning Design on Flat Shape Material

Figure 3 shows that the results of the exploration of the Rumah Gadang are used as the primary basis in developing learning designs based on realistic mathematics education (RME).

After Rumah Gadang's mathematical ideas are integrated into practical mathematics learning tools based on mathematics education (RME), the learning design will be evaluated formatively (one to one and small group) to investigate the validity and practicality of the learning design has been designed. In this case, what is being tested is a learning device with a flat topic.

After preliminary analysis and self-evaluation, the learning device was validated by five experts consisting of three mathematicians, one linguist, and one educational technology expert. The experts' evaluations obtained an average of 3.66, which is in the very valid category.

After the learning design is valid, it is followed by a one to one evaluation trial on three high, medium, and low ability students. The following is an example of the answers of students in the one to one stage can be seen in Figure 4

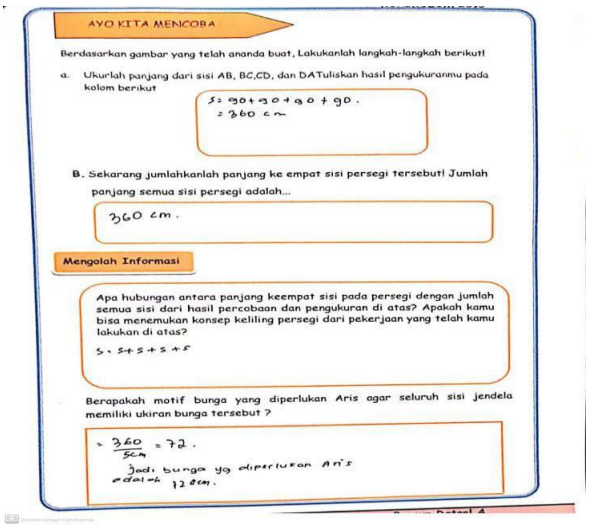

Figure 4 Example of Students' Answers in the One to One Evaluation Stage

After the one to one stage, a small group evaluation was carried out on six students: two high, two moderate, two low ability students. The following are examples of students' answers, which can be seen in Figure 5.

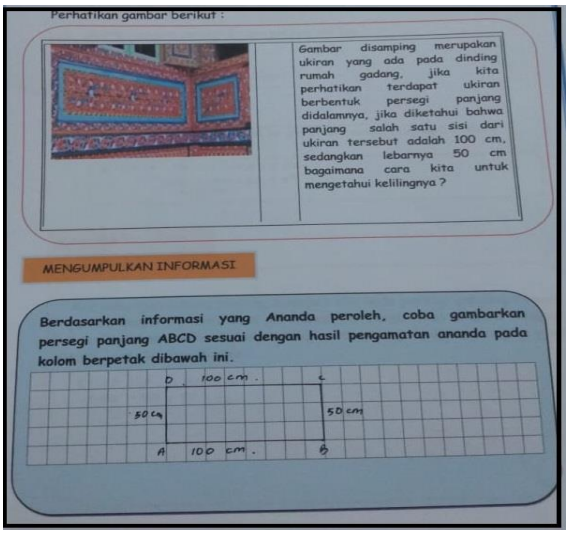

Figure 5 The Result of the Answers of Group 1 Students at the Small Group Evaluation Stage

After conducting a small group evaluation, interviews were conducted with two students who were representatives of each group. From the interviews conducted, it was concluded that students liked LKPD based on Ethnomatics of Rumah Gadang, with LKPD based on ethnomatics of Rumah Gadang, can help them find and understand every material studied.

Apart from interviews, students were also given a questionnaire to see the practicality of the learning tools used. Based on students' practicality questionnaire results, the table shows three practical aspects, namely didactic aspects, ease of use, and time. The presentation / didactic aspect has a practicality value of 88.19%, the ease of use aspect has a value of 90.97% in the efficient category, the time aspect has a value of 91.67%, it is also in the efficient category. In contrast, the readability aspect has a practicality value of 83, 33, in the practical category, so that the average practicality value of the whole device is 88.54% with the efficient category.

4. CONCLUSION

Based on the study results, it can be concluded that the RME learning design, which is compiled based on the exploration results of the Minangkabau Rumah Gadang, has been in the valid and practical category to be used in the next stage, namely the field test.

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