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IMPROVING MATHEMATICAL MEANINGFUL ABILITIES OF NATIVE STUDENTS IN THE PELABUHANRATU REGION USING AN ETHNOMATHEMATICS APPROACH

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Abstract: Understanding that mathematics is a subject that is difficult to believe because mathematical concepts are abstract and, therefore, difficult to comprehend and understand. Students' abilities and skills in mathematics subjects in Indonesia are relatively low. However, this can only be generalized to some Indonesian students, considering that Indonesia is a large country with many students. This research aims to describe customs, traditions, and culture holistically, then apply them to mathematics learning activities through ethnomathematics studies for indigenous students with the hope that mathematics learning will become more meaningful when studying mathematics. According to Spradley, this research method is descriptive qualitative with an ethnographic approach and a gradual progressive research flow. The result of this research is that the ethnomathematics approach has succeeded in making mathematics, which was often abstract, become real. Indigenous students who study ethnomathematics-based mathematics feel that the mathematics lesson material becomes logically meaningful; students can also absorb the material into their cognitive structure. Indigenous students who learn ethnomathematics-based mathematics can learn mathematical material by interpreting each element of mathematics culture or combining the two into ethnomathematics.

Keywords: Ethnomathematics, Indigenous Student, Meaningful Abilities

INTRODUCTION

Mathematics is one of the important materials in the Indonesian education curriculum. This is based on Republic of Indonesia Law no. 20 of 2003 concerning the National Education System Article 37 paragraph (1), which states that the primary and secondary education curriculum must contain mathematics, one of which is. Koellner said that mathematical ability is a skill or capacity related to students' knowledge and skills in mathematics (Koellner et al., 2011); (Sanjaya et al., 2018). Mathematics ability is the target to be achieved in mathematics learning. Ramdhani et al. (2015) stated that there are five basic mathematical abilities: problem solving, reasoning, proof, communication, connections, and representation (Anggoro et al., 2022). Based on this statement, mathematical representation ability is one of the basic mathematical abilities that students must have. The representation standards set by the National Council of Teachers of Mathematics (NCTM) for learning programs from pre-kindergarten through grade 12 are that they must enable students to (Alabdulaziz & Higgins, 2021): (1) create and use representations to organize, record, and communicate ideas mathematics, (2) selecting, applying, and translating between mathematical representations to solve problems, (3) using representations to model and interpret physical, social, and mathematical phenomena.

Based on TIMSS (Trend in International Mathematics and Science Study) data in 2015, according to Nizam (in Hadi & Novaliyosi, 2019), Indonesia is 44th out of 49 countries. This means that the abilities and skills in mathematics and science subjects in a sample of students in Indonesia could be a lot higher (Asfahani & Fauziyati, 2020). However, this cannot be generalized to all Indonesian students because Indonesia is an archipelagic country where there is a possibility that one region or certain students will be able to achieve high scores in international scale evaluations (Leasa et al., 2021). Students must continue to be trained by teachers to develop a concept of mathematical thinking and understand a concept in a flexible manner that is appropriate through mathematical representation (Cai & Ding, 2017); (Baker & Galanti, 2017).

Implementing mathematical representations that align with the environment around students will spark more concrete mathematical ideas. Students become more stimulated to continue studying mathematics because a concept does not become complex but becomes simpler. Therefore, this mathematical ability is very important for students because it can make it easier to develop their mathematical ideas. Firdaus (2019) stated that one of the reasons why students' low interest in learning mathematics is because mathematics is still seen as a difficult subject for students. According to Prayuga (2019), mathematics is a subject that students fear, so students have less interest in learning mathematics. This results in poor student learning achievement.

This research is urgent considering that empirical evidence shows that students' mathematics achievement in Pelabuhanratu could be more optimal, and there is a deep gap in understanding mathematical concepts. Data shows that students need help relating mathematical concepts to their daily lives, resulting in a less meaningful understanding of mathematics (Andamon & Tan, 2018). The ethnomathematics approach has the advantage of bringing local cultural context into mathematics learning, and previous research shows that its application can increase student motivation and understanding (Fouze & Amit, 2017); (Abdurahman et al., 2023). Therefore, this research reflects the deep need to improve the mathematics abilities of indigenous students in Pelabuhanratu by utilizing a more contextual and meaningful approach through ethnomathematics.

Fuadiah (2016), in his research, stated that the majority of mathematics education experts and mathematicians stated that abstract objects of mathematics study were the things that most often caused students obstacles in understanding mathematics. Apart from that, Martdiastuti, in his research, concluded that most students consider mathematics subjects to be subjects with a high level of difficulty because mathematics is an abstract science that is difficult to understand. After all, it is not real. Thus, one solution that concerns researchers is bringing mathematics learning closer to real things to make it easier to understand. This research aims to describe customs, traditions, and culture holistically, then apply them to mathematics learning activities through ethnomathematics studies for indigenous students with the hope that mathematics learning will become more meaningful when studying mathematics.

METHODS

According to Spradley, this research method is descriptive qualitative with an ethnographic approach and a gradual progressive research flow. The qualitative method uses the library as the main source and other literature related to this paper's discussion topic. Researchers analyze for good results based on the writer's hopes and objectives. The results of the analysis will be included in the discussion and results. In qualitative field research, researchers are directly involved in field situations, such as observing, interviewing, or interacting with participants. Researchers collect data directly from the source through direct observation, in-depth interviews, field notes, or audio/video recordings (Sugiyono, 2017). The data is then analyzed and interpreted to reveal emerging patterns, themes, or meanings. Then, it is analyzed using an inductive model. This model is intended to clarify the data reduction process to create meaning from the raw data collected. These findings were obtained to interpret basic information; researchers used interviews to follow up on these findings. Interviews were conducted to find out the problems that occurred. The interview needed to be more

structured. In the end, researchers also added observation as an important source of data triangulation (Sugiyono, 2019). Data validity was carried out using content, technical, and reference triangulation.

The findings on ethnomathematics in the Pelabuhanratu area, Sukabumi Regency, were obtained through observations since January 2023. Observations were made to the people in the Pelabuhanratu area regarding the culture they know. The majority of people said that the culture that people still trust includes fishermen's day ceremonies, seren taun ceremonies, calculating good days for carrying out traditional ceremonies, building a house, going sailing, farming, and calculating the compatibility of couples who will get married and calculating good days for celebrations.

Based on the results of community observations, researchers are interested in exploring the calculation of good days. The community-directed researchers visit several houses of people usually asked by the community (Martiskainen, 2017); (Collins et al., 2018). However, not all upanayana information could be extracted by researchers. Among several upanayana or elders who did not permit their information to be explored, in the end, there were two elders, or the term for elders in the Pelabuhanratu area, who gave permission and access for researchers to study the science of counting good days. or it could also be called palak science.

Furthermore, observations were made with the elders regarding ways to calculate good days. Researchers observed and conducted interviews in stages according to Spradley's ethnographic method. The first interview was conducted in mid-January 2023 with Citarik Village, Pelabuhanratu informants. The second interview was conducted in mid-February 2023 with the same informant. The results of the interviews obtained were the origins of the calculation of palak knowledge, although there were many things that the informants should have allowed to be disseminated.

Only one interview stage was conducted in March 2023 for the second elders or questions. This was because the researcher already had information from the informant (first elder) to develop questions for one interview. The next step taken by the researcher was to interview the Deputy Principal (wakasek) for the curriculum section and the mathematics teacher. This interview was conducted in three stages with an interval of one week in September 2023. The interview was conducted with a mathematics teacher who teaches advanced mathematics in class XI. The results of observations were also carried out on indigenous students by giving family genealogy assignments, after which the researchers monitored the development of indigenous students' learning methods during the learning activities.

RESULTS AND DISCUSSIONS

Result

Alternative Selection of Ethnomathematics-Based Mathematics Teaching Materials

Teaching materials were designed after completing interviews with traditional elders from March to July 2023. It was discovered that the information conveyed by the informants (elder one and elder 2) was that there was a connection between culture and selected mathematics or specialization mathematics in class XI regarding polynomials and subchapter remainder theorem. Teaching materials are presented with an introduction to culture, information on its use, examples of calculations in cultural activities, and questions related to culture and mathematics. These questions are designed to be done in groups, and some are also done individually.

Mathematical Representation Skills in Indigenous Students

The results of observations made on indigenous students showed that students' mathematical representation abilities were quite varied. In terms of the mathematical representation ability of indigenous students in solving mathematical problems presented by researchers, indigenous students use the representation of cacarakan characters in the problems given, which can be easily solved. Based on the results of researchers' interviews with indigenous students, the ability to translate mathematical representations to solve problems is difficult because the environment in which they live does not use the culture presented by researchers. Several other students also said they needed more time to represent cultural issues about mathematics.

Meaningfulness of Ethnomathematics-Based Mathematics Learning

Based on the observations and interviews, students learn meaningfully when studying ethnomathematics-based mathematics, especially as the culture studied is close to the environment where students grow and develop. Some of the students had also known about this kind of culture before, but the majority, in interviews, students admitted that they had only just learned about the culture of counting good days as they had learned.

Furthermore, students can absorb the material into their cognitive structure. This can be seen in how students solve problems given by researchers, whether working independently or in groups. They can also combine elements and connect new material related to culture with mathematics subjects regarding the remaining theorem they have previously studied. Regarding indicators of meaningfulness, indigenous students who take part in ethnomathematics-based mathematics learning can learn mathematical material by interpreting each element of mathematics culture or by combining the two into ethnomathematics.

Table 1. The Results of Ethnomathematics in the Pelabuhanratu Region

No.	Cultural Aspects	Description	Link with Mathematics	Related Mathematics Learning Activities
1	Upacara Adat	Analysis of the traditional ceremonies of the Pelabuhanratu Region	Application of geometric concepts in ritual layout	Using geometric elements to model custom ceremonial layouts
2	Folklore	Identify mathematical patterns in stories	Apply arithmetic and geometry patterns in stories	Creating problem-solving activities based on folklore
3	Traditional Art	Analysis of symmetry in traditional art	Understanding the concept of symmetry through traditional art	Create mathematical art projects that explore the concept of symmetry
4	Agricultural System	Study the agricultural system of society	Application of comparison and proportion in agricultural systems	Using comparative concepts to analyze agricultural produce
5	Rituals of Daily Life	Observation of daily rituals	Application of statistical concepts to analyze ritual data	Use data from rituals to create graphs and statistics

The table above provides an overview of some aspects of culture and how to integrate these elements into maths learning activities. The table reflects efforts to link cultural aspects, such as traditional ceremonies, folklore, traditional arts, agricultural systems, and rituals of daily life, with mathematics learning for indigenous students. Each aspect of the culture is analyzed to identify mathematical concepts that can be applied, such as geometry in traditional ceremonial layouts, arithmetic patterns and geometry in folklore, symmetry in traditional arts, comparison and proportion in agricultural systems, and statistical concepts in daily ritual data. The results of this analysis are then linked to relevant mathematics learning activities, such as the use of geometric elements in modeling the layout of traditional ceremonies or the application of statistical concepts to analyze ritual data. The main goal of this approach is for mathematics learning to be more meaningful and connected to the cultural context of indigenous students.

Discussion

Ethnomathematics in the Pelabuhanratu Region

Most people in Pelabuhanratu still carry out activities related to the local culture of their area. Some of the cultures that are still carried out and trusted by the community are fishermen's day ceremonies, seren taun ceremonies, calculating good days for carrying out traditional ceremonies, building houses, going sailing, farming, and calculating the compatibility of couples who will get married and calculating good days for celebrations.

Of the many cultural riches of the Pelabuhanratu community, researchers chose to explore the calculation of good days. The community helped direct researchers to visit figures usually used as Panamanian (places to ask questions) (Umbara et al., 2021). Even though not all the people who asked were willing to be interviewed for their information, some elders were willing to be interviewed because the culture of arithmetic is a cultural treasure that needs to be preserved so that many people can understand it and use it in their daily lives. Continuity and preservation of culture are the main reasons elders are willing to provide information about palak.

Furthermore, observations were made with the elders regarding ways to calculate good days. Researchers observed and conducted interviews in stages according to Spradley's ethnographic method. In this case, the researcher conducted two interviews one month from the first to the second. This pause was carried out so that the researcher could analyze the results of the first interview to raise questions for the next interview.

The first interview was conducted in mid-January 2023 with Citarik Village, Pelabuhanratu informants. Residents in the Pelabuhanratu area recommended this informant several times. The informant in this interview called this calculation élmu palak. Using the cacarakan script, the counter can calculate good days for a couple's compatibility, good days for holding a celebration, and good days for traveling.

The second interview was conducted in mid-February 2023 with the same informant. The results of the interviews were the origins of the calculation of palak knowledge, although there were many things the informants would hallow to be disseminated. The informant also explained the calculation of lost items, permitted and prohibited travel time each day within 24 hours, and partners' compatibility based on birthdays.

Only one interview stage was conducted in March 2023 for the second elders or questions. This was because the researcher already had information from the informant (first elder) to develop questions for one interview. The interview results with the second elder were similar to those with

the first. Still, there were several additions, such as calculating with Pancake Seven and Pancake 12 to calculate partner compatibility, celebrations, and travel time.

The next step taken by the researcher was to interview the Deputy Principal (wakasek) for the curriculum department. Interviews were carried out in stages through three in August 2023, at one-week intervals. The results of interviews with the curriculum section include the characteristics of students being diverse, the students accepted into the school are the result of zoning, the independent curriculum has only been implemented for one year and several months, and teachers are still developing modules for this independent curriculum. After interviewing with the deputy head of curriculum, the researcher interviewed with the mathematics teacher. This interview was conducted in three stages with an interval of one week in September 2023. The interview was conducted with a mathematics teacher who teaches advanced mathematics in class XI.

The results of interviews with mathematics teachers include the administration of learning tools made by themselves by the directions of the curriculum and teachers carrying out teaching and learning activities with a tendency toward students actively searching for material and understanding it. Then, in the independent curriculum, mathematics teachers still tend to learn to follow the appropriate methods to use during teaching and learning activities in class (Agustina et al., 2023). The teacher carries out evaluations with students working on the parts they have left behind and does not give additional assignments.

Indigenous students were given family genealogy assignments, after which the researchers monitored the development of indigenous students' learning methods during the learning activities (Sánchez Tapia et al., 2018). Indigenous students have different learning patterns from non-indigenous students. Indigenous students communicate more using the local language, including group learning activities. These indigenous students communicate using the local language even when discussing mathematics-related matters.

Alternative Selection of Ethnomathematics-Based Mathematics Teaching Materials

Teaching materials were designed after completing interviews with traditional elders from March to July 2023. It was discovered that the information conveyed by the informants (Elder One and Elder 2) was that there was a connection between culture and selected mathematics or specialization mathematics in class XI regarding polynomials and subchapter remainder theorem.

Alternative teaching material selection is made with 90% cultural material and 10% remaining theorem mathematical material. However, the cultural material written in teaching materials includes many things related to the mathematical material of the remainder of the theorem. Teaching materials

are presented with an introduction to culture, information on its use, examples of calculations in cultural activities, and questions related to culture and mathematics (Asfahani, 2019). These questions are designed to be done in groups, and some are also done individually.

The response of mathematics teachers when seeing the selection of ethnomathematics-based mathematics teaching materials looks enthusiastic and gives appreciation. The mathematics teacher concerned also responded that the culture presented by the researcher was also believed in his cultural life.

Mathematical Representation Skills in Indigenous Students

The results of observations made on indigenous students showed that students' mathematical representation abilities were quite varied. In terms of the mathematical representation ability of indigenous students in solving mathematical problems presented by researchers, indigenous students use the representation of cacarakan characters in the problems given, which can be easily solved. However, of the 61 students, only 38 could represent the mathematical problems the researcher gave. The remaining students experienced difficulties because they needed help understanding the basic theory in learning mathematics provided by researchers.

Based on indicators of mathematical representation ability according to NCTM, these include (Utomo & Syarifah 2021) (1) using representations (verbal, symbolic, and visual) to model and interpret physical, social, and mathematical phenomena, (2) creating and using representations (verbal, symbolic and visual) to organize, communicate mathematical ideas, and (3) select, apply and translate representations (verbal, symbolic and visual) of mathematics to solve problems.

Based on the results of researchers' interviews with indigenous students, the ability to translate mathematical representations to solve problems is difficult because the environment in which they live does not use the culture presented by researchers. Several other students also said they needed more time to represent cultural issues about mathematics.

Meaningfulness of Ethnomathematics-Based Mathematics Learning

Based on the observations and interviews, students learn meaningfully when studying ethnomathematics-based mathematics, especially as the culture studied is close to the environment where students grow and develop. Some of the students had also known about this kind of culture before, but the majority, in interviews, students admitted that they had only just learned about the culture of counting good days as they had learned.

Indicators of meaningful learning, according to Ausubel (Vargas-Hernández & Vargas-González, 2022), are:

1. The material to be studied must be potentially meaningful. The meaningfulness of the material depends on the following two factors: (a) the material must have logical meaning, namely material that is nonarbitrary and substantive, and (b) relevant ideas must be present in the student's cognitive structure.
2. Students who will study must aim to carry out meaningful learning.

As concluded (2019), meaningful learning will occur if the following three components are fulfilled:

1. Subject matter must be logically meaningful;
2. Students should aim to incorporate the material into their cognitive structures, And
3. In students' cognitive structures, elements must be suitable for linking new material in a non-arbitrary and substantive manner.

Indigenous students who study ethnomathematics-based mathematics feel that the mathematics subject matter becomes logically meaningful. However, some students deny that calculations like this can only be studied and cannot be trusted. Furthermore, students can absorb the material into their cognitive structure. This can be seen in how students solve problems given by researchers, whether working independently or in groups.

In students' cognitive structures, they can also combine elements and connect new material, namely related to culture, with mathematics subjects regarding the remainder theorem that have previously been studied. Regarding indicators of meaningfulness, indigenous students who take part in ethnomathematics-based mathematics learning can learn mathematical material by interpreting each element of mathematics and culture or by combining the two into ethnomathematics.

This research tries to fill knowledge gaps and present new contributions in the context of improving the mathematics abilities of indigenous students in Pelabuhanratu by applying an ethnomathematics approach. While previous research highlights the success of ethnomathematics in improving mathematical understanding, this research focuses on indigenous students in Pelabuhanratu, a cultural context that may have its uniqueness and challenges. By considering the local cultural background, this research seeks to strengthen previous findings by showing the applicability and effectiveness of the ethnomathematics approach in increasing the meaning of mathematics for students in the Pelabuhanratu area. Thus, this research provides added value and contextual relevance to the understanding and application of ethnomathematics to improve students' mathematical abilities.

CONCLUSION

Based on the discussion above, the ethnomathematics approach has made mathematics, often abstract, become real. The culture of counting good days (elmu palak) close to students' daily lives makes it easier to understand mathematical concepts. Indigenous students who study ethnomathematics-based mathematics feel that the mathematics lesson material becomes logically meaningful. Besides, students can also absorb the material into their cognitive structure. Indigenous students who learn ethnomathematics-based mathematics can learn mathematical material by interpreting every element of mathematics culture and combining the two into ethnomathematics. Implementing ethnomathematics can positively impact students' understanding of mathematical concepts by linking them to the local cultural context. This can increase the sense of relevance and meaning of mathematics in their daily lives and strengthen students' cultural identity. In addition, it can develop learning strategies that suit the unique context of Pelabuhanratu, hoping to increase student's motivation, engagement, and overall mathematics achievement.

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