Available online at: http://ijer.ftk.uinjambi.ac.id/index.php/ijer
IJER (Special Edition)
The 3rd International Conference on Education (Icon 2023)
Vol. 8 No.3 (16-23)

The Role of Ethnomathematics in Mathematics Learning

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Abstract

Ethnomathematics is one of the fields of study of mathematics applied by certain cultural groups. Ethnomathematics is learning based on local culture so that students can simultaneously recognise and explore the culture of their nation. This research aims to find out the role of ethnomathematics in learning mathematics. This research is a type of literature research with a qualitative approach. How to collect data by means of document studies and analysed with descriptive analysis techniques. Library research is research whose data comes from books, documents, magazines, journals and so on. The analysis technique used is descriptive analysis technique by looking at research data that has been carried out by previous researchers related to ethnomathematics research. Based on a review of previous research, the result of this study is that ethnomathematics has many roles in learning mathematics, including: 1) improving mathematical understanding skills, 2) improving students' mathematical abilities, 3) strengthening cultural wisdom in mathematics learning, 4) developing mathematical literacy skills, and 5) developing media for mathematics learning.

Keywords*: Ethnomathematics, Mathematics, Learning role*

1. Introduction

Maths was conceived as a subject separate from art and culture by earlier people. As science developed and academics realised the connection between mathematics and local culture, the term ethnomathematics was introduced. Ethnomathematics consists of two words, namely ethno and mathematics. Ethno means culture and mathematics is the study of counting, measurement, logical thinking and problem solving.

Ethnomathematics is a study of mathematics in the form of a study of a form of culture (ideas, activities, or cultural objects) that has become a characteristic of a particular community group (Soebagyo et al., 2021). Ethnomathematics is the study of the cultural and mathematical side of something that has cultural value. Nowadays, researchers conduct ethnomathematics studies in their local areas. This is inseparable from the identity of the Indonesian nation which has ethnic, racial and cultural religions.

Ethnomathematics can be defined as a special way that a particular group performs mathematical activities. The form of ethnomathematics itself is the result of mathematical activities owned or developed in the group itself (Sariningsih & Kadarisma, 2016). Ethnomathematics in learning has become an approach for educators in instilling mathematical concepts to students. The ethnomathematics approach is a new model for educators in improving the understanding of mathematical concepts realistically while introducing cultural values that can be translated in terms of mathematics. Of course this can motivate students to learn mathematics more realistically where mathematics is taught in various forms of abstract symbols and numbers.

Ethnomathematics-based learning is a follow-up to mathematics learning. Cockroft (Sarwoedi et al., 2018) argues that mathematics needs to be taught to students because: (1) it is always used in all aspects of life; (2) all fields of study require appropriate mathematical skills; (3) it is a strong, concise, and clear means of communication; (4) it can be used to present information in various ways; (5) it improves logical thinking, accuracy, and spatial awareness; and (6) it gives satisfaction to the effort of solving challenging problems. From these various reasons for the need for schools to teach mathematics to students, it can essentially be concluded that mathematics is a problem related to the problems of everyday life.

Ethnomathematics has an important role in learning, as the results of the study (Putra & Prasetyo, 2022) on

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"The Role of Ethnomathematics in the Basic Concepts of Mathematics Learning" that the role of ethnomathematics in supporting the basic concepts of mathematics learning is that ethnomathematics facilitates students to be able to construct mathematical concepts as part of mathematics learning based on students' knowledge of their socio-cultural environment. In addition, ethnomathematics provides a learning environment that creates good motivation and is more fun so that learners have a great interest in participating in mathematics learning which is expected to affect their mathematics skills.

Ethnomathematics has many roles in learning mathematics, two of which are in accordance with the discussion above. In this study, the purpose of the research is to find out the roles of ethnomathematics in learning mathematics based on previous studies, journals, books and other documents that support this research.

The roles of ethnomathematics described in the study (Putra & Prasetyo, 2022) on "The Role of Ethnomathematics in the Basic Concepts of Mathematics Learning" concluded that ethnomathematics can generate students' understanding in the process of learning mathematics. In the research "Contribution of Ethnomathematics as a Contextual Problem in Developing Mathematical Literacy" explains that ethnomathematics has a contribution in the process of contextualising mathematics (Kehi et al., 2019). Ethnomathematics as done by (Marsigit. Marsigit et al., n.d.) on "Development of Ethnomathematics-Based Mathematics Learning" found that ethnomathematics is a new innovation in mathematics learning in the form of developing learning tools. The development of ethnomathematics-based mathematics learning tools includes modules, syllabus, lesson plans and student worksheets.

In a study on "Ethnomathematics as an Effort to Strengthen Local Wisdom in Mathematics Learning" concluded that ethnomathematics is considered relevant not only to develop students' mathematical abilities, but also to strengthen the values of local wisdom in these students. (Chrissanti, 2018).

Therefore, this research was written by summarising the roles described in the research separately into a single unit. The role of ethnomathematics in mathematics learning was summarised by the researcher to include five parts, namely: 1) improving mathematical understanding skills, 2) improving students' mathematical abilities, 3) strengthening cultural wisdom in mathematics learning, 4) developing mathematical literacy skills, and 5) developing media for mathematics learning. These five roles will be discussed in the discussion section of this study.

2. Method

This research is a type of literature study research with a descriptive qualitative approach. Literature study research or known as library research is research using data sources from books, documents, journals, e-books, and other written documents as data in research. The data sources used have a relationship with the research title. The data collection technique used is to collect data sources that are in accordance with the research objectives.

The literature review was drawn from research (Putra & Prasetyo, 2022) on "The Role of Ethnomathematics in Basic Concepts of Mathematics Learning". The literature from (Kehi et al., 2019) on "The Contribution of Ethnomathematics as a Contextual Problem in Developing Mathematical Literacy". Research by (Marsigit. Marsigit et al., n.d.) in the Proceedings of the Ethnomanesia National Seminar discusses "Development of Ethnomathematics-Based Mathematics Learning". Research by (Chrissanti, 2018) in her research on "Ethnomathematics as an Effort to Strengthen Local Wisdom in Mathematics Learning". Research by (Kencanawaty et al., 2020) on "The Contribution of Ethnomathematics in Primary School Mathematics Learning". Research by (Soebagyo et al., 2021) on "Analysing the Role of Ethnomathematics in Mathematics Learning". And research by (Sarwoedi et al., 2018) on "The Effectiveness of Ethnomathematics in Improving Students' Mathematics Comprehension Skills".

3. Results and Discussion

Ethnomathematics consists of two words, ethno (ethnic/cultural) and mathematics. It means that in ethnomathematics, mathematics is related to culture (Kehi et al., 2019). The term Ethnomathematics was first introduced by a Brazilian mathematician, D'Ambrosio in 1977. The word ethnomathematics comes from 3 words, namely "ethno" which means something that refers to a cultural context, which includes language, jargon, mythical behavioural codes, and symbols. Furthermore, the word "mathema" means explaining, knowing, understanding, and doing activities such as: coding, measuring, clarifying, inferring, and modelling. Finally, the word "tics" which comes from the word "techne" and has the same meaning, namely technique. (Muyassaroh & Dewi, 2021).

Ethnomathematics is the mathematics applied by certain cultural groups, labour/farmer groups, children from a certain class of society, professional classes, etc.

(D'Amborsio, 1985). Culture in this context has a broad and unique perspective and is inherent in people's customs, for example: gardening, playing, creating and solving problems, how to dress, and so on. Ethnomathematics combines mathematics with culture will have a dual function if applied in learning, in addition, to make learners easier to understand the subject matter can also assess the values contained in their culture (Kehi et al., 2019).

Learning with ethnomathematics can be a series of learning activities that make students active in learning. The use of mathematical concepts in ethnomathematics is broadly related to various mathematical activities, including grouping activities, counting, measuring, designing buildings or tools, playing, determining locations and so on. Ethnomathematics applied to mathematics learning can recognise and use connections between mathematical ideas in solving a problem. So, with ethnomathematics-based learning, students can learn maths while getting to know the culture (P. Lestari et al., 2023).

Mathematics that emerges and develops in the community and is culturally appropriate, is central to the learning process and methods of teaching. This opens up pedagogical potential by taking into account learners' knowledge gained from learning outside the classroom. By taking a particular theme, learning mathematics can be done contextually so that it will provide new experiences and insights for learners. Through ethnomathematics, learning will be more memorable because it introduces local traditions and cultures that are still recognised and practised by certain community groups (Putri, 2017) in (Soebagyo et al., 2021).

The word mathematics comes from the Latin word "mathematika" which was originally taken from the Greek "mathematike" which means study. the origin of the word mathema which means knowledge or science. The word "mathematike" is also related to another word that is almost the same, namely "mathein" or "mathenein" which means learning or (thinking). So, from that, mathematics means knowledge obtained by thinking (reasoning). Mathematics emphasises activities in the world of ratios (reasoning), rather than emphasising the results of experiments or observations. Mathematics is formed because of human thoughts, which relate to ideas, processes, and reasoning (Gazali, 2016).

The National Research Council revealed that in order to develop mathematical thinking and the ability to solve problems, learners need to "do" mathematics. The general objectives of learning mathematics include placing emphasis on structuring reasoning and shaping the attitudes of learners, namely placing emphasis on skills in the application of mathematics, both in everyday life and in studying other sciences (Chrissanti, 2018). Active learning in mathematics means that learners are brought into an activity of observing, guessing, doing, trying, being able to answer why questions, and if possible arguing. This active learning principle is then expected to foster creative and critical mathematics learning goals. Through the principle of active learning, mathematics learning in schools is expected to achieve success (Chrissanti, 2018).

Ethnomathematics is an approach to learning mathematics that involves students actively exploring local culture into a mathematical perspective, students are able to see mathematics in real life and ethnomathematics is a learning approach that trains students to think logically and mathematically. Apart from playing a role in some of the things mentioned, ethnomathematics also has an important role in learning mathematics that supports the achievement of mathematics learning objectives. These roles will be explained below.

Referring to research (Kencanawaty et al., 2020) on the Contribution of Ethnomathematics in Mathematics Learning with the research subjects of principals, teachers and students of SD Negeri 8 Ciseureuh, Kahuripan, Pajajaran, Purwakarta. This school is a pilot project of a Sundanese culture-based school. Learning activities at school in the learning process apply several Sundanese words.

The Sundanese have a tradition of community life that has been passed down from their ancestors such as cultural activities and traditional games. Cultural activities in the villages are very thick with swimming and fishing in the river, whistling, making bamboo crafts, herding livestock, ploughing rice fields, etc. While traditional games are playing rebutan, kites, jumping ropes, tops, and others. Because cultural activities and traditional games are often carried out by the community, these activities are ingrained in children. (Muzdalipah & Yuliyanto, 2015).

Research in (Kencanawaty et al., 2020) explained that the cultural field that has mathematical elements in learning is the practice of planting rice in the rice field. The mathematical concept in question is that the distance between plants must be the same and not too close. This means that the plants get enough nutrients and minerals. Planting rice fields is done backwards, not forwards. This is so that when the plants are planted, they will not be trampled. This activity in addition to honing students' affective and psychomotor abilities also makes space in learning activities not monotonous in the classroom. Practical learning of planting in the rice field contributes to students being able to understand every

culture in their homeland has a symbolic in mathematics and has meaning. This makes learners become critical in understanding mathematics in their lives.

Ethnomathematics that has a relationship with mathematics understanding is also explained in research (Putra & Prasetyo, 2022) on the Role of Ethnomathematics in Basic Concepts of Mathematics. In his research, he explained a study conducted by (Arwanto, 2017) The study on the exploration of ethnomathematics of Trusmi Cirebon batik in revealing the value of philosophy and mathematical concepts shows that Trusmi Cirebon batik contains mathematical elements, including the concepts of geometric symmetry, transformation (reflection, translation, and rotation), and congruence.

In addition, there is a traditional outfit called Pesa'. Pesa' is the name for the typical Madurese men's wear. This outfit consists of a t-shirt with a stripe pattern in red and white colours combined with a loose black shirt and pants. The colours and stripe motifs on the Pesa' shirt have the meaning of assertiveness and courage as well as the spirit of hard work (Arifah, 2013). The mathematical concept found in Pesa' clothing is the concept of parallel lines found on Pesa' T-shirts.

The role of ethnomathematics in supporting the basic concepts of mathematics learning is that ethnomathematics facilitates students to be able to construct mathematical concepts as part of mathematics learning based on students' knowledge of their socio-cultural environment. In addition, ethnomathematics provides a learning environment that creates good motivation and is more fun so that students have a great interest in participating in mathematics learning which is expected to affect their mathematics skills. (Putra & Prasetyo, 2022).

Research described by (Sarwoedi et al., 2018) on the Effectiveness of Ethnomathematics in Improving Students' Mathematical Comprehension Skills. This study discusses the mathematical understanding ability of students, with indicators including: 1) identify and make examples and non-examples, 2) translate and interpret the meaning of symbols, tables, diagrams, images, graphs, and mathematical sentences, 3) understand and apply mathematical ideas, 4) make an exploration (estimate) (K. E. Lestari & Yudhanegara, 2018).

Research result (Ayu et al., 2016) shows that there are differences in results between classes that use Sundanese ethnomathematics learning and classes that do not use Sundanese ethnomathematics learning. This is indicated by the results of the t test which produces a significance value of 0.00 where the value is less than 0.05 so that H0 is rejected, meaning that there is a difference. From the gain test, the experimental class obtained a medium gain value and students' attitudes towards ethnomathematics learning showed a positive trend. This shows that Sundanese ethnomathematics learning has an effect on students' mathematical understanding skills.

Research result (Asnawati et al., 2015) The results showed that the mathematical understanding ability of students who received inquiry learning with ethnomathematics was better than the mathematical understanding ability of students who received conventional learning with the mathematical understanding achievement of experimental class students was 19.44 and the control class was 17.16.

Ethnomathematics brings out cultural wisdom so that it can motivate students in learning mathematics. In learning mathematics, there are several abilities that affect student learning achievement. Among these mathematical abilities are mathematical literacy skills (Fajriyah, 2018). A culture of literacy is expected to realise a smart, skilled and noble generation. Efforts to achieve this can be made by reading various literacy materials that contain religious, moral and cultural values in the context of Indonesian nationality and statehood (Fajriyah, 2018).

Permendiknas No. 22 of 2006 concerning Content Standards for Mathematics Subjects in the scope of basic education states that mathematics subjects aim for students to have five key abilities as follows: (1) understand mathematical concepts, explain the interrelationships between concepts and apply concepts or algorithms flexibly, accurately, efficiently and appropriately in problem solving; (2) use reasoning on patterns and properties, perform mathematical manipulations in making generalisations, compiling evidence, or explaining mathematical ideas and statements; (3) solve problems that include the ability to understand the problem, design a mathematical model, solve the model and interpret the solution obtained; (4) communicate ideas with symbols, tables, diagrams, or other media to clarify the situation or problem; and (5) have an attitude of appreciating the usefulness of mathematics in life, namely having curiosity, attention, and interest in learning mathematics, as well as a tenacious and confident attitude in problem solving (OECD, 2013). These skills include reasoning mathematically and using mathematical concepts, procedures, and facts to explain and predict phenomena.

In (Fajriyah, 2018) his research on the Role of Ethnomathematics Related to Mathematical Concepts in Supporting Literacy concluded that one way to support mathematical literacy is innovation in mathematics learning. One of them is by incorporating

ethnomathematics elements in learning. Culture-based mathematics learning (Ethnomathematics) is one way that is perceived to make mathematics learning more meaningful and contextualised which is closely related to the cultural community. In addition, culture-based mathematics learning will be an interesting, fun and innovative learning alternative because it allows contextual meaning based on students' experiences as members of a cultural community so that it is expected to participate in supporting the literacy movement.

The ethnomathematics learning process, one of which is the discovery learning model. As explained (Rachmawati & Purwaningrum, 2019) in his research on the Ethnomathematics-Based Discovery learning Model on Space Buildings to Foster Literacy Skills and Nationalism Character in Generation Z 4.0 explains that the implementation of Indonesian culture associated with mathematical concepts to students can be done using an ethnomathematics-based discovery learning model. By applying cultural elements in mathematics learning, students are certainly more motivated to explore and get to know the various cultures that exist in Indonesia. so that with efforts to apply the ethnomathematics-based discovery learning model, students will not abandon existing Indonesian culture.

In research (Iqrima et al., 2023) on the development of ethnomathematics-based statistics questions in improving mathematical literacy skills, it was found that content validity by experts resulted in an average score of 0.9155, meaning that the questions can be said to be valid with the "Very High" category. Empirical validity at the trial stage resulted in an average score of 0.7137, which means that the question can be said to be valid. Based on the student response questionnaire, it can be seen that the practicality of the product in general can be categorised as practical with an average value of practicality of 3.38 and the percentage of practicality is 84.5%. The question is also declared reliable with a reliability value of 0.807 which means that the reliability is included in the very high category. Overall, the product of developing mathematics questions in ethnomathematics-based class VIII statistics material to measure students' mathematical literacy is valid and practical.

In general, ethnomathematics can be seen as a concept of learning mathematics within a cultural and anthropological framework. In ethnomathematics, students are not only invited to develop their mathematical abilities but also maintain the culture that is the original character of their nation. Therefore, ethnomathematics is considered relevant not only to develop students' mathematical abilities, but also to strengthen the values of local wisdom in these students (Chrissanti, 2018).

Local wisdom is a view of life and knowledge as well as various life strategies in the form of activities carried out by local communities in responding to various problems in fulfilling their needs. Thus, the local wisdom that develops in the community of a particular region can be different from that in other regions depending on the availability of materials and means of fulfilling the needs of the community in that region. This creates a separate culture in the community that is not necessarily owned by people in other regions (Chrissanti, 2018).

According to Goldberg, culture-based learning with ethnomathematics can be done in three ways: learning about culture, learning with culture, and learning through culture (Supriadi et al., 2016). Meanwhile, the study of ethnomathematics in mathematics learning covers all areas: architecture, weaving, sewing, agriculture, traditional dances, batik cloth, kinship relations, ornaments, and spiritual and religious practices (Ekowati et al., 2017).

Research by (Chrissanti, 2018) discussing Ethnomathematics as an Effort to Strengthen Local Wisdom in Mathematics Learning concluded that implementing mathematics learning with a cultural base is not impossible. In this case, teachers are required to develop creativity in finding cultural elements that can be brought into the context of student mathematics learning. So that mathematics lessons are no longer taught as abstract concepts, but also as concepts that are close to students' daily lives and grow as a product of the culture in which students learn. Thus students will have good mathematical knowledge as well as an understanding and love of their cultures. Globalisation has a serious negative impact on the younger generation in the form of a tendency to make western culture a mecca for lifestyle so that they forget their identity as Indonesians. Strengthening local wisdom values can be done early on through learning activities at school, one of which is learning mathematics through ethnomathematics. Implementing mathematics learning with ethnomathematics can be done by developing teaching materials that integrate mathematical material with elements of the culture where students learn.

In (P. Lestari et al., 2023) His research on the Development of Problem Based Learning (PBL) Learning Tools Containing Ethnomathematics to Improve Mathematics Literacy Skills obtained the results of making the developed devices including lesson plans, teaching materials, media, LKPD, Mathematics Literacy Questions. The results of device validation were obtained as follows: RPP received a

percentage value of 86.46% in the very valid category, teaching materials of 87.80 in the very valid category, Media of 88.54% in the very valid category, LKPD of 87.50% in the very valid category, trial questions of 87.82% in the very valid category. The practicality test was obtained from student and teacher questionnaires which were declared practical by students by obtaining an average score of 87.80 in the very good category and the practicality and readability response by the class teacher obtained a score of 87.5 in the very good category, and based on peer assessment obtained a score of 86.25 in the very good category. The effectiveness test used is paired sample t test and n gain test. The sample t test results get a sig value. 0.000, while the n gain test results get a value of 0.41 with a moderate improvement category. The results showed that the PBL mathematics learning tool with ethnomathematics content developed was proven to be valid, practical and effective so that it was suitable for use in learning mathematics.

Research (Marsigit. Marsigit et al., n.d.) which discusses the development of ethnomathematics-based mathematics learning. The development of ethnomathematics-based mathematics learning tools includes modules, syllabus, lesson plans and student worksheets. Ethnomathematics is a local culture-based mathematics learning approach; therefore, in the Yogyakarta and surrounding areas, ethnomathematics development research can take place in 3 places, namely Borobudur Temple, Prambanan Temple, and Yogyakarta Palace. The development of this learning tool, Student Activity Sheet contains activities that can stimulate critical thinking skills through ethnomathematics-based learning of Yogyakarta Palace. The Student Activity Sheet consists of a Circle student worksheet containing student worksheet 1 (elements of a circle and the relationship between the elements of a circle) and student worksheet 2 (circumference and area of a circle), as well as a flat-sided space student worksheet containing student worksheet 1 (surface area of cubes and beams), student worksheet 2 (surface area of prisms and pyramids), student worksheet 3 (volume of cubes and beams), and student worksheet 4 (volume of prisms and pyramids). The critical thinking skills test aims to prove whether the learning tools developed are effective in stimulating students' critical thinking skills. The test was conducted at the end of the study after the last meeting. The test is a critical thinking ability test with test questions based on ethnomathematics of Yogyakarta Palace which is open-ended. The test results were then analysed as a whole and based on critical thinking indicators to determine the effectiveness of the learning tools developed.

Research on Developing Mathematical Literacy Skills Through the Use of Modules Based on the Realistic Mathematics Education Approach with Cultural Values found that this study looked at students' literacy skills by using modules based on the Realistic Mathematics Education (RME) approach with cultural values. The use of modules in learning developed according to student needs can help students in learning to develop students' literacy skills, the modules used have gone through validation tests and effectiveness tests so that they can be implemented to students, this research design is a non-equivalent control group design, consisting of control classes and experimental classes. From the results of the study, it is known that the use of modules based on the RME approach with cultural values can improve students' literacy skills by 78% which can be classified as effective (Saputra et al., 2021).

In addition to the learning media described by some of these studies, online media can also be developed based on ethnomathematics. As has happened during the covid-19 period, schools require all learning processes to be carried out remotely. The distance learning innovation tested in his research on the potential of ethnomathematics-based mobile learning during the covid period. Mobile learning based on ethnomathematics can be applied in distance learning during the pandemic (Auliya et al., 2020). Research result (Wahid et al., 2020) showed that the development of mobile learning media using Adobe Flash Professional with the ethnomathematics approach of Kudus tower was effectively applied in learning mathematics. The application of mobile learning increases students' interest in learning while improving student learning outcomes.

Implementation of Flipped Classroom with Ethnomathematics Nuances in his research. The result of the research is that this study implements a flipped classroom with ethnomathematics nuances in online learning in geometry and measurement courses to investigate its effect on increasing students' learning independence and mathematical literacy skills based on the results of statistical tests in this study, namely two-sample t test, paired t test, and gain test. The results showed an increase in learning independence and mathematical literacy skills of students with the application of flipped classroom with ethnomathematics nuances with Elena support in online learning of geometry and measurement (Kiptiyah et al., 2021).

4. Conclusion

Ethnomathematics is one of the fields of study of mathematics applied by certain cultural groups.

Ethnomathematics is learning based on local culture so that students can simultaneously recognise and explore the culture of their nation. The study of ethnomathematics is a hot topic for mathematics researchers. Findings obtained based on relevant research show that ethnomathematics has many roles in mathematics learning, including: 1) improving mathematical understanding skills, 2) improving students' mathematical abilities, 3) strengthening cultural wisdom in mathematics learning, 4) developing mathematical literacy skills, and 5) developing media for mathematics learning.

This research is still unable to explain the role of ethnomathematics completely and perfectly, as a support for research progress, the researcher suggests that future researchers examine the effectiveness of innovations in the use of ethnomathematics-based learning media related to mathematical thinking and mathematical communication skills.

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